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BACK NUMBERS OF THE JOURNAL.

Members are notified that the price of back numbers of the JOURNAL has been reduced to a maximum of 10s. 6d. per issue, and that the price for complete volumes (unbound) is £2 2s. A complete set of any ten volumes can be obtained at £20 and Vols. I. to X. also include the Decennial Index covering those volumes.

SPECIAL MEETING.

A Special Meeting of the Institution of Petroleum Technologists will be held on June 14th, 1932, at which it is proposed to exhibit new laboratory apparatus and objects of general interest, and to have presented a series of short papers descriptive of the exhibits. Those desirous of taking part are requested to inform the Secretary of the nature of their exhibit in due course.

THE INSTITUTION OF PETROLEUM TECHNOLOGISTS

NOTICES.

The Institution as a body is not responsible for the statements of opinion expressed in any of its publications.

Copyright. Authors of papers and articles are requested to transfer their copyright to the Institution for a period of six months from the date of receipt of the paper. Such transfer should be made in writing when the manuscript is forwarded to the Editor.

Editors are permitted to publish abstracts, providing that acknowledgment is made to The Institution of Petroleum Technologists.

Issue of Journal. The Journal is issued in twelve parts per volume, commencing in January of each year. The Title Page, Table of Contents and Index to each volume are published in the second issue of the succeeding volume.

Members whose subscription is not in arrear receive the Journal free of cost, and additional copies are charged at the rate of 7s. 6d. per part, unless otherwise stated. A member whose subscription is not paid by March 31st of the year for which it is due is considered to be in arrear.

Changes of Address. Members are requested to notify any change of address to the Secretary.

Papers and Articles. Members are invited to submit papers to be read at the General Meetings of the Institution, and are specially asked to forward articles for consideration for publication in the Journal. Diagrams, illustrations, etc., should be suitable for direct photographic reproduction. Authors are informed that all papers, whether for reading or for publication, will be submitted to a referee nominated by the Publication Committee.

Authors of papers published in the Journal are entitled to receive 25 free reprints of their contribution. Further copies may be obtained on payment, and orders for these should be sent to the Secretary when the manuscript is forwarded to the Editor. The free reprints do not include any discussion which may be published with the paper, but authors may have such discussion included in their reprints on payment of the additional cost.

Galley proofs of the paper to be read at a General Meeting are available at the time of the meeting, but members desirous of receiving such galley proofs in advance should apply to the Secretary.

Binding of Journals. Members desiring to have their Journals bound in cases should send them, together with a remittance of 5s. 6d. per volume, to Messrs. Speaight & Sons, Ltd., 98, Fetter Lane, London, E.C. 4. A charge of 7s. 6d. will be made for binding Vol. 10, 1924. Remittance in all cases must accompany the order.

Abstracts. Abstracts of the more important articles and patent specifications are published with each issue of the Journal, this supplement being paged independently of the transactions. Members and Journal Subscribers desiring to have the Abstracts printed on one side of the paper only can be supplied with these at a charge of 10s. per annum per copy, payable in advance.

Medals. The Redwood Medal is awarded, at the discretion of the Council, to the person who shall have made the most meritorious contribution to petroleum technology, in the form of a paper or papers published in the Journal of the Institution, during two successive sessions, preference being given to original work and to papers which have been read before the Institution and discussed. The award is not confined to members of the Institution and may be withheld if no contribution is considered to be of sufficient merit.

A medal and a prize of five guineas is awarded annually by the Council to that Student Member of the Institution who shall, in their opinion, have presented the best paper during the session.

Benevolent Fund. The Benevolent Fund is intended to aid necessitous persons who are or have been members of the Institution, and their dependent relatives.

The Fund is raised by voluntary annual subscriptions, donations, and bequests, and all contributions should be sent to the Secretary of the Institution at Aldine House, Bedford Street, London, W.C. 2. The Fund is administered by the Council through the Benevolent Fund Committee, and all applications in connection therewith must be made on a special form which can be obtained from the Secretary of the Institution.

Appointments Register. A register of members requiring appointments is kept at the office of the Institution for the convenience of firms requiring the services of petroleum technologists, etc., it being understood that the Institution accepts no responsibility and gives no guarantee.

Library. The Institution's Library may be consulted between the hours of 11 a.m. and 4 p.m. daily. (Saturdays, 11 a.m. to 12 noon.)

Advertisements. Advertisements are inserted in the Journal, and information as to terms, etc., can be obtained from Mr. Thomas Tofts, 301-302, Bank Chambers, 329, High Holborn, W.C. 1. (Telephone No. Hol. 4776.

LIST OF ADVERTISERS.

Members are desired when making enquiries or placing orders with advertisers to mention that they have seen their announcement in the Journal.

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PERSONAL NOTES OF MEMBERS AND SPECIAL NOTICES.

It is suggested that members send information regarding their movements to the Secretary, for insertion under this heading.

Mr. A. G. V. BERRY has returned to Trinidad.

Mr. J. D. BING is in Iraq.

Dr. E. CLARK has left Holland and is now in Venezuela.

Mr. R. W. DUNSTER has left South Africa for Melbourne, Australia.

Mr. W. ENGLISH is home from Egypt.

Mr. D. A. GREIG has returned from Iraq.

Mr. J. MCWILLIAMS is home from Trinidad.

Mr. W. A. PETERS has been paying a visit to England.

Mr. M. A. RUST is home from Iraq.

Mr. G. W. R. TAYLOR has returned from Persia.

Mr. E. E. UPTON is home from Iraq.

Mr. V. J. WILMOTH has returned to Burma.

It is with regret that we announce the resignation, on account of ill health, of Miss Clare Despard from the position of Librarian of the Institution. Miss Despard joined the Staff of the Institution in April, 1922, and during most of the time has had charge of the Library. In that capacity she was well known to many of our members, and we feel sure that all will join us in wishing her a speedy and complete recovery to good health.

The Secretary would be glad to learn of the whereabouts of the following members :—D. McP. Armstead, C. A. Bauduin, T. E. Beaumont, N. M. Brodie, C. R. Clark, E. H. Crush, B. Dvorkovitz, J. W. Elder, P. M. Falconer, W. M. Gray, J. Haker, L. B. Holloway, E. A. Howard, P. Norman Hulme, C. E. Jobling, W. Light, H. Leslie Little, A. MacLean, E. Moscovici, F. A. I. Muntz, R. E. Palmer, Nand Lal Pasi, E. C. Scott, W. E. Shepherd, E. F. H. Spencer, D. Steel, C. M. Stoney, L. J. Truss, R. K. Van Sickle, F. E. G. Watson and S. S. Webb-Bowen.

OBITUARY.

LORD FORRES, P.C.

It is with regret that we announce the death of the Rt. Hon. Lord Forres, P.C., on October 29th, 1931, at the age of 71.

Born on September 13th, 1860, Archibald Williamson was the eldest son of Mr. Stephen Williamson, M.P., and a grandson of Dr. Thomas Guthrie. After being educated at Craigmount School and Edinburgh University, he joined the firm of Balfour, Williamson & Co. He represented Elgin and Nairn in Parliament from 1916 to 1918, and Moray and Nairn from 1918 to 1922. During his time in the House of Commons he served on several public inquiries and was Chairman of a number of Committees. He was created a baronet in 1909 and in 1922 was created Lord Forres.

He was the owner of the first motor car seen in Liverpool and was a keen sportsman, his Forfarshire seat holding many trophies, both from the Scottish deer forests and from abroad.

He was chairman of Lobitos Oilfields, Ltd., from its incorporation in 1908 and of the Anglo-Ecuadorian Oilfields, Ltd., from its formation in 1919, and became a Member of the Institution of Petroleum Technologists in 1924.

A man of considerable charm, his presence will be greatly missed in many circles, and we extend our deepest sympathy to his family and to his many friends.

DUNCAN GARROW.

We regret to announce the death of Mr. Duncan Garrow on September 25th, 1931. He had been a Member of the Institution since 1919, and was formerly a Director of the Anglo-Persian Oil Co., Ltd.

DINNER CLUB.

The attention of members is drawn to the Dinner Club of the Institution. This Club holds informal dinners after each General Meeting of the Institution and members may invite guests. Those desiring to receive notice of these dinners are requested to inform the Secretary of the Institution.

SMALL ADVERTISEMENTS.

In future the advertisement columns of the Journal will be open for the inclusion of small prepaid advertisements, such as Situations Vacant and Wanted, Patents for Sale and Miscellaneous, at a charge of 1s. 0d. per line of seven words (minimum 4s. 0d.). A charge of 1s. 0d. will be made for the use of a box number. Matter for insertion should be in the hands of the Associate Editor not later than the 12th of the month in which it is desired that the advertisement should appear.

NOMINATIONS FOR MEMBERSHIP OF THE INSTITUTION OF PETROLEUM TECHNOLOGISTS.

The following have been nominated for membership of the Institution of Petroleum Technologists and their Application Forms may be seen at the Offices of the Institution :—

As Members:—	PROPOSED BY	SECONDED BY
BAKER, Thomas Clarence, Chemist, Ridgway, 57, Lansdowne Road, S. Woodford, E. 18	W. H. Wright.	F. B. Crow.
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FORTESCUE, Sydney John, Petroleum Engineer, c/o Messrs. Indo-Burmah Oilfields (1920), Ltd., Thayetmyo, Burma	Murray Stuart.	A. E. Dunstan.
YOUNG, Charles Reginald, Chemist, Strada Elena Doamna 46, Ploesti, Rumania	J. E. Treacy.	F. W. Penny.

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FRENCH, Alan, Chemical Assistant, 37, Elborough Street, Southfields, London, S.W. 18	J. W. Amner.	A. M. Beavan.
LEWIS, Walter Ronald, Engineer, c/o Cia Mexicana de Petroleo "El Aguila" S.A., Apartado 86, Puerto Mexico, Ver., Mexico	R. Schider.	R. H. Ames.
WILSON, Alfred, Engineer, c/o The Rising Sun Petroleum Co., Yokohama, P.O. Box No. 401, Japan	J. Kewley.	P. E. Joyce.
As Transfer to Associate :—		
PEWSNER, Paul, Engineer, P.O. Box 453, Haifa	V. C. Illing.	A. A. Ashworth.

THE INSTITUTION OF PETROLEUM TECHNOLOGISTS.

THIRTEENTH ANNUAL DINNER.

THE THIRTEENTH ANNUAL DINNER of the Institution of Petroleum Technologists was held at the Connaught Rooms, Great Queen Street, London, on Friday, October 9th, 1931, the Chair being taken by the President (Mr. James Kewley), who was supported by Mr. Alfred C. Adams (Past-President), Professor J. S. S. Brame, C.B.E. (Past-President), Sir John Cadman, G.C.M.G. (Past-President), Mr. Ashley Carter (Member of Council), Mr. C. Dalley (Member of Council), Mr. T. Dewhurst (Vice-President), Dr. A. E. Dunstan (Past-President), Mr. Arthur W. Eastlake (Vice-President and Honorary Secretary), Mr. B. J. Ellis (Member of Council), Dr. F. H. Garner (Member of Council), Mr. John Gillespie (Member of Council), Mr. J. S. Jackson (Member of Council), Professor A. W. Nash (Member of Council), Mr. J. McConnell Sanders (Member of Council), Mr. George Sell (Associate Editor), Commander R. E. Stokes-Rees, R.N. (Secretary), Mr. William Sutton (Member of Council), Dr. F. B. Thole (Member of Council), and Mr. A. Beeby Thompson, O.B.E. (Member of Council).

Among those present were also: Lieut.-Col. S. J. M. Auld, O.B.E., M.C., Mr. R. Beaumont, Col. C. H. Bressey, C.B.E. (Chief Engineer, Roads Dept., Ministry of Transport), Mr. F. G. Bristow (General Secretary, C.M.U.A.), Mr. W. A. S. Calder (President, Institution of Chemical Engineers), Sir Robert Waley Cohen, K.B.E., Air Vice-Marshal H. C. T. Dowding, C.B., C.M.G. (Air Member for Supply and Research), Mr. C. R. Fairey, M.B.E. (President, Royal Aeronautical Society), Mr. Homer S. Fox (Assistant Commercial Attaché, U.S.A.), Mr. A. Hittinger, Mr. C. Le Maistre, C.B.E. (Director, B.E.S.A.), Dr. G. T. Morgan (President, Society of Chemical Industry), Mr. F. Handley Page, C.B.E., Major-General S. C. Peck, C.B., D.S.O. (Director of Mechanization, War Office), Sir Robert Robertson, K.B.E., F.R.S. (Government Chemist), Mr. E. Shrapnell-Smith, C.B.E., Eng. Vice-Admiral Sir R. W. Skelton, K.C.B., C.B.E., D.S.O. (Engineer-in-Chief of the Fleet), and Mr. F. C. Starling (Director, Petroleum Dept.).

"The King."

The Toast of "The King," proposed by the President, was loyally received.

The President announced that telegrams had been received from the Trinidad and Persian Branches conveying their greetings

to the parent Institution. The Institution would reply to these telegrams.

Members would be interested to hear that the Trinidad Branch were holding their Annual Dinner on October 24th, and were being honoured by the presence of the Governor of Trinidad, Sir Alfred Claud Hollis. (Applause.)

The President said his next duty was to present the Student's Medal to Mr. N. G. Gullick. (Applause.) The Medal was awarded annually to the student who, in the opinion of the Awards Committee, had presented the best paper to the Students' Section during the year. On the present occasion the members of the Awards Committee had been unanimous that the Medal and Prize should be awarded to Mr. N. G. Gullick for his paper on "The Determination of Mean Molecular Weights of Lubricating Oils by Improved Cryoscopic Methods."* The paper was a very good one, and had the merit of originality.

The President then, amid applause, presented the Medal to Mr. Gullick, who briefly acknowledged the honour.

The President said the following papers were commended :—"Shale Mines of Scotland," by Mr. C. F. C. Moore, and "Oil Field Waters," by Mr. T. Gordon Robson.

"The Users of Petroleum."

Sir John Cadman, G.C.M.G., D.Sc., in proposing the toast, said :—

Before I embark on the subject of my toast, may I take this opportunity both of congratulating Mr. Kewley on his promotion to the Presidential Chair and the Institution on being so fortunate as to have such a President. No one commands a greater respect amongst its general body of members, or is more qualified than he for the post he occupies. (Applause.) He is a most worthy successor to my old friend Dr. Dunstan.

The toast which it is my pleasure to propose is one which I am sure will commend itself to all of you, particularly as I am to couple with it the names of certain speakers who represent in themselves an excessively wide range of general users.

Perhaps I may be allowed to start by traversing a little past history. As I am sure you all know the earliest biblical reference to petroleum is in Genesis. Pitch, we are told, was used in building the Tower of Babel; and it is a noteworthy fact that the oil industry has never again spoken with one voice. (Laughter.) Later on we learn from that very observant traveller Marco Polo

* J. Inst. Petr. Techn., 1931, 17. 541-571.

that petroleum was good for the mange in camels. It may have cured the hump in those days, but I am bound to confess that much of this particular virtue seems to have gone out of it now-a-days. (Laughter.)

In the 18th century the inhabitants of the Caucasus drank petroleum as a cordial and medicine; it was supposed to be particularly good for the stone and sore heads—but, unfortunately, it did not intoxicate, so the Russians took to vodka. The Caucasians also used white naphtha for dry-cleaning purposes. "It takes out greasy spots in silks and woollens," it is recorded, "but the remedy is worse than the disease, for it leaves an abominable odour."

In the Caucasus again, an unruly tribe led by Nadir Shah, were persuaded to give up their evil ways, to settle on the land and sell naphtha to the local inhabitants. They accepted and carried on a brisk trade for a couple of years. Then "getting tired of this way of living, they returned to their trade of piracy." Now-a-days we are more ingenious, for ways and means seem to have been found in certain quarters for combining the sale of naphtha with the trade of piracy. (Laughter.)

ANNUAL DINNER.

Most of us—petroleum technologists included—never give two thoughts to many of these secondary uses of petroleum. We think of it in terms of fuel, engines, and so on; but forget that there are millions to whom it means something quite different. It is a lubricant—an internal lubricant. Millions of men and women used to have to swallow some foul drug mixed with water, or worse, in ever-increasing doses; but petroleum came along—and now, the bed-time hour holds no terrors and the morning bath no fears.

Malaria is not always cured by quinine; but mosquitoes are killed—before they see the light—by petroleum. Enough oil poured on the waters will, in fact, kill any damn thing, including fish. I recommend it to those who use the old-fashioned rod and line—it's quicker and more certain. (Laughter.)

When a ship that burns coal is caught in a hurricane it just sinks and Lloyd's call it an Act of God. But an oil-burning ship pumps its sludge or some heavy fuel oil on to the waves and gets away with it—cheap at £2 a ton—a guinea a bottle ought to be the price at such times.

How is glass etched? It is covered with wax, and then the design is scratched on it. The hydrofluoric acid eats the glass, but not the wax—oh, no!—it takes more than that to affect paraffin—hence its value as an internal lubricant.

Chewing gum, likewise, is made of petroleum wax and gives strong, silent men that hard-faced look.

And now let us turn to the real users—the hard-faced men themselves. Among them, the Navy and the Mercantile Marine claim first mention by reason of their seniority as users of petroleum, the importance of the quantities they consume, and the controversy that is now proceeding on the subject of coal or oil as the appropriate fuel for the Navy.

I believe that the use of fuel oil for the purpose of raising steam in boilers antedated that of petrol for land locomotion. Fuel oil—or mazout—was a commonplace on the Caspian long before its adoption was considered in other parts of the world. The Navy took to oil cautiously—as it was bound to do—but it soon discovered that, in oil, it had found the fuel it needed.

The first submarine was constructed, I believe, about 1900. Three years later an experiment was tried, in certain battleships, of installing apparatus to spray fuel oil on the burning coal at times when the greatest head of steam was needed. The earliest Naval vessels—destroyers—relying solely upon oil, were launched in 1906, and at the end of the War the Navy had virtually abandoned—I believe for all time—the use of coal as its major fuel.

I read in a newspaper a few weeks ago that, in a certain ship, a burnished coal shovel was displayed as a reminder of what had been. The device above it was "Lest we forget." That shows one Navy view about oil and coal. It is reinforced by the words of the late Parliamentary Secretary to the Admiralty: "Were the Navy to revert to coal as fuel we should be accepting a handicap in design which would be a most serious setback and could not now be undertaken without grave prejudice to the strength of the Fleet and its operational efficiency."

Nevertheless, there are always people whose minds hark back to the good old days. Seventy or eighty years ago, the same type of idealist cursed coal and steel and clamoured for the Navy's return to "white wings and wooden walls." Let it be said, in passing, that romance was all on their side. To-day, they ignore not only fuel oil, but also the vastly greater potentialities of the Diesel engine. (The new German Diesel-engined pocket battleship has a "steaming radius" of 10,000 miles and a speed of 26½ knots.) "The keenest brains in the Navy"—I read recently—"know that smokeless coal is the best all-round fuel for the Navy." I have, however, seen no parallel announcement by any distinguished gunner that cannon-balls are the best all-round ammunition.

The lessons of the War—fortified by post-war developments—have given rise to remarkable changes in other military arms. The Air Force is, of course, a direct offspring of petroleum. In the early days of the War, British and German pilots, meeting in the course of their reconnaissances, would wave hands to one

another. But that spirit of amity did not last long; and the Air Force is now a fighting weapon as potent as the older arms. Moreover, it has replaced the limited and fugitive vision of cavalry by the eyes of a hawk and the indelible impress of a camera-plate.

Meanwhile, cavalry itself has become mechanical; the tank has revolutionized warfare; and the I.C. engine has taken transport from the horse. Napoleon's army marched on its stomach; the army of to-day marches on hydrocarbons.

The motor industry has not reached its present eminence without difficulties. For many years we heard complaints that our system of taxation was crippling the trade; and that the horse-power tax would be its ruin. Our manufacturers trimmed their sails to that ill-wind by building diminutive but efficient cars, and have kept a steady course ever since. Thanks to the skill and ability of the motor industry, imports of foreign cars have dwindled to the point, almost, of imperceptibility.

In the air, British engines are supreme in speed. The hazards and dangers of civil aviation have virtually disappeared; and we journey by aeroplane with no more trepidation than by train. For that progress we are indebted to many men—some who were courageous in facing the unknown risks of adventure into a new element; some whose skilled brains attacked—and solved—the problems of flight; many in whom those attributes—and others—were combined.

The spirit of progress, the spirit of adventure, the spirit of manifold achievement—that is the spriit of petroleum, and of the men who use it by sea, air and land. Vice-Admiral Sir Reginald Skelton (amongst whose many decorations I notice with respect the white ribbon of, I presume, a blameless life) is the distinguished representative here of the first element. (Applause.) No less a person than Mr. Fairey, President of the Royal Aeronautical Society, represents the Air (Applause); and, had his engagements not intervened, we should have Sir Herbert Austin to speak for the land. We might do ourselves the pleasure of considering him present in spirit here to-night.

The names of these gentlemen, and what they stand for, are familiar to us all, and you will agree with me that in their persons the vast company of the users of petroleum is most worthily represented. To them, and to all those they represent, I raise my glass.

The toast was enthusiastically received.

Engineer Vice-Admiral Sir Reginald W. Skelton, K.C.B., C.B.E., D.S.O., who was received with applause on rising to respond, said:

"The Users of Petroleum" is a pretty comprehensive toast, and must include almost the whole human race.

As a patriotic Englishman, I suppose I have to plead guilty to the charge of being a heavy user of a material which is not produced in this country. Even there I am in very good company, for we have with us to-night General Peck, who is Director of Mechanisation at the War Office, and Air Vice-Marshal Dowding, who is responsible for the consumption of large quantities of petroleum in the air.

Although we are guilty of using a product which is not a home product, we use as little of it as possible. (Laughter.) We investigate from day to day every possible method we can for using less and less and getting more and more power. In that respect I think we are not doing bad work. The Navy has been a user of furnace oil fuel now for nearly thirty years. It has been developing its use for nearly thirty years. It was a pioneer in the development of burning oil fuel under boilers, and every development in the way of improved combustion has been made inside the Navy; we have not had to pay a penny in royalties for any outside invention, and we have now got to a position where our combustion is so complete, or so very nearly complete, that we only require 12½ per cent. over the theoretical quantity of air required to burn that oil fuel. I think that is not a bad position at which to have arrived.

When I joined the Service, about forty years ago, we were burning anything from 4 to 6 lb. of best Welsh coal to produce 1 h.p. In one of our latest ships we have got to the position of burning 0·6 lb. of oil fuel to produce 1 h.p. In other words, the economy has increased about tenfold. Of course, we cannot do as well as we might, because, after all, a ship of war does not want to carry any oil fuel and does not want to carry any machinery, if it can possibly help it; it wants to carry guns. We have to do the best we can with the limited space and the limited weight we are allowed. The Mercantile Marine can do still better, and I had hoped to see my friend Captain Gillies, Superintendent of the Canadian Pacific line, here to-night. He would tell you that they have even got below 0·6 lb. of fuel per h.p. per hour which we obtained in the Navy.

Sir John Cadman has referred to the interesting controversy that goes on from time to time—we in the Navy regard it as a hardy annual—on the merits of coal and oil. I was privileged, two or three nights ago, to listen to a most excellent paper, a summary of the situation with regard to the fuel question in this country, by a very celebrated member of your Institution, Dr. W. R. Ormandy, and to the discussion on that paper. Some part of the discussion was excellent. I am not sure I thought that of all of it, but I am not really in a position to judge. At any rate, Dr. Ormandy dealt very briefly and very faithfully with those who had the audacity

to controvert any of the remarks in his paper. (Laughter.) One distinguished gentleman suggested that we should use coal for the Navy in peace-time and oil in war-time. (Laughter.) Dr. Ormandy's reply was brief; he said: "As for the distinguished gentleman who suggested coal, my answer to him is 'bows and arrows.'" (Laughter.)

Dr. Ormandy can do that sort of thing, but I do not know that I can; I have to go into reasons. Well, I can give a few reasons. If I were to give you all the reasons and to discuss the question fully, I should take up a considerably longer time than you would like; but, to put it briefly, let me say this. You can compare oil fuel with coal in certain ways, where you can provide certain fixed numbers or figures for each characteristic. You can give absolutely comparable figures for heat value; you can give comparable figures for weight and for volume and for certain other things. But when you come to design a warship and a warship's machinery you cannot equate the comparable figures. There are no comparable figures when you come to design the thing that you want to produce—namely, a warship; the advantages of using petroleum are so enormous.

The advantages are so great because your designs are now limited by certain Naval Conventions. It is not altogether a question of coal *versus* oil, for we must have our fuel in liquid form, and we must have it neat; no water, thank you. (Laughter.)

I do not suppose anything I can say will stop this controversial question; it is an everlasting one, and at present it is a newspaper one; and newspapers must have their fuel as well as everybody else. (Laughter.) But, speaking of the Defence Forces of this country, if you have Defence Forces at all—and, after all, we are very small, the Army is very small and the Air Force is very small—you must have them efficient. There is no excuse for having them inefficient; it would be better not to have any at all. The Defence Forces—the Navy, the Army and the Air Force—are vital to this country, and they must be efficient. So far as fuel is concerned, I think you can leave it to them to see which is the fuel with which they will perform the services you require of them most efficiently. In other words, the gentlemen who doubt our case for petroleum fuel would do better to appeal to our sympathy rather than our reason.

I have referred only to furnace fuel. Of course, in the Navy we do use other fuels as well, but not in very large quantities. We use a certain amount of petrol, which we are trying to do without, and we use a certain amount of Diesel engine fuel, which some people think we might use in larger quantities; but, gentlemen, do not rush us. We also use lubricating oils, again in as small

quantities as we possibly can, and we lay down certain specifications to meet our own requirements which I believe are regarded as rather severe. I think, however, we are entitled to make them severe as long as we can get what we want, and I believe those severe specifications are sometimes regarded by the petroleum suppliers as a mark of excellency.

Now, before sitting down, perhaps I might retaliate on Sir John Cadman. He has proposed the toast of "The Users of Petroleum"; perhaps I might say a word about the suppliers. I have nothing against the suppliers at all; but occasionally gentlemen come to see me in my office who whisper that the suppliers of petroleum are responsible for almost all the evils of this world. (Laughter.) They darkly hint that they oppose every form of progress for this country, and that their tentacles go out to all parts of the world and do us damage. Well, that has not been my experience. My experience is that the suppliers of petroleum are ready to meet us in every way, and I have found them to be a body of people who are ever investigating, looking into and studying one of the most complicated structures that is known, petroleum, with a view to benefiting the human race. They employ every form of scientist. They have the most wonderful salesmen. They have the most striking advertisements. (Laughter.) I think, in fact, that there is nothing much wrong with the petroleum industry.

I should like to say a good deal more about the petroleum industry, but I must stop. I have to reply to the toast of the Users, and I thank Sir John Cadman for the felicitous terms in which he has referred to the Users, and I thank you, gentlemen, for the very kind way in which you have received the toast. (Applause).

Mr. C. R. Fairey, M.B.E., who also responded, said: I feel greatly honoured by being selected to reply to the toast so ably proposed by Sir John Cadman, but I feel hardly qualified to do everything that your President apparently expects me to do. He wrote to me and explained that he had originally wished there should be three responses to this toast, for Sea, Land and Air, but that owing to shortage of time it was necessary to cut them down to two. Moreover, it appears that the products of petroleum, like many other things in this world, are divided into the black and the white (Laughter), and he went on to suggest that whereas Sir Reginald Skelton would deal with the black side (as he has very ably done) it would naturally fall to me to deal with the white. I did not mind that so far as it referred to aviation fuels, or even internal combustion engine fuels; but when I saw from the list of white users that it included candles and kerosine I felt a little inadequate, and still less do I feel capable of responding on behalf

of those users of petroleum referred to by Sir John Cadman (Laughter), who doubtless consume these chemical products which, according to the advertisements, are so extremely efficacious (Laughter).

I shall therefore, with your permission, confine my remarks to the question of aviation. Compared to the heavy oil fuel users, we are very small fry, but doubtless we have demanded, and I am sure we have received, more than our share of technical attention from the Institution of Petroleum Technologists.

Aviation, as far as the machine was concerned, was perfectly possible seventy years ago, when Mr. Stringfellow launched his famous model. Had he possessed an internal combustion engine even one-tenth as good as those in ordinary use to-day he would have achieved mechanical flight, and by sheer experience found the necessity of adding those very few features to his machine which would have made of it a complete if somewhat primitive aeroplane. Seventy years ago the aeroplane was far ahead of the equivalent motor car or light transport locomotive of those days; both were awaiting the coming of the internal combustion engine before they could be made practicable.

As an aeroplane designer, I have no hesitation in admitting—indeed, I am glad to admit—that the greater part of the progress which has been made since Wilbur Wright flew in 1903 has been due to the engine designer and the petroleum technologist as much as, if not more than, to the aircraft designer or technician. I do not mind telling you the secret of producing a perfect aeroplane. If you want to make a successful aeroplane you adhere very carefully to the specifications and requirements, and you design it round an engine of a certain horse-power; then you instal in it an engine of much greater horse-power, and there you are (Laughter). In that little secret you will find the reason of the success of every successful aeroplane to-day (Laughter).

Behind the work of the petroleum technologist is that of the aeronautical designer and the designer of the engine. Their work this year has culminated in the most spectacular effort that even our industry has so far achieved, in that we have won, and won for good, the Schneider Trophy and have raised the speed record to the almost incredible figure of 410 miles an hour (Applause). I give you the accurate figure, not the published one. You might not expect it to be more than the published one, but it is; that is the true figure. Before we take too much credit to ourselves, however, and before I hand over too much credit to you, my hosts, you must remember that a large part of the credit for bridging the gap between that and the previous record is due not only to the designers, but to the amazing skill of the pilot (Applause).

Now, gentlemen, the lay public are well accustomed to measure these spectacular events in terms of speed and so on, doubtless to their own satisfaction, but to the technically-minded the figures which relate to engine development and fuel development are possibly of equal interest. The original engine used by the Wright Brothers weighed 40 lb. per horse-power, and it consumed over ¾ lb. of fuel per horse-power hour. The Rolls-Royce engine used by Flight Lieutenant Stainforth weighed only just over ½ lb. per horse-power, and consumed only just over ½ lb. of fuel per horse-power hour. The actual weight was 0·6 lb. per horse-power. Even that figure for consumption was beaten by the Napier Lion engine used for the British long-distance record flight, which consumed only 0·46 lb. or less than ½ lb. per horse-power hour.

You may have noticed that some five or six years ago there was something of a lull in this progressive advance of aviation, and I, speaking as a representative of aviation to-night, am only too willing to admit that the progress which has since been made has been very largely due to the work of petroleum technologists. It is the time and money which have been spent on research which makes these advances possible. As I say, five or six years ago there was a lull, and then suddenly aviation started going forward again with even bigger annual strides than before. Six years ago the speed record seemed to have stuck at just over 200 miles an hour, and after remaining there for some time it suddenly started to mount again. I am very pleased to acknowledge that that new start and the progress which has been made since are very largely due to the work of petroleum technologists. In that interval you have given us these anti-detonating fuels which make possible the use of compression ratios more than double those to which we were accustomed, and that has been to a large extent responsible for the engine development which has taken place; and I admit it has been more engine development than aircraft development which has accounted for the astounding progress of these last few years.

In the early days we simply bought petrol. Some of it smelt more than others, but that was about all the physical difference we ever noted (Laughter). To-day we buy petrol to rigid specification, in which the aromatic content, the specific gravity and the other qualities attributable to a good fuel are all carefully proportioned. It is to the work of the petroleum technologists that we owe that, and it is that which has rendered possible the development to which I have referred.

In fact, we feel that fuel research has in some ways gone ahead of the engine. I never miss an opportunity of saying a few nasty things about carburettors. That unbelievably archaic apparatus still holds up the beautiful mechanisms the engineers provide for us.

I will only say this, that if we had the sort of carburettor we deserve then I could see before us another big jump in aeronautical progress, without asking anything more of you gentlemen who provide us with these nearly perfect fuels.

I say "nearly perfect" because we still want a few more things. We in aviation would like a non-detonating fuel as good as the heavily-doped petrols, which is innocuous, which could be stored in bulk and could be used and handled with as little danger as the lower-grade fuels we used to use. I think that is almost all I can ask of you at present (Laughter), unless I could suggest to Sir John Cadman that we should have a tax-free fuel. We have tax-free dividends from oil companies; why should not we have a tax-free petrol? (Laughter).

In conclusion, I am very pleased on behalf of aviation, and also, so far as it refers to them, on behalf of the candle-makers and the medicine-takers and other users (Laughter), to acknowledge the great contribution which petroleum technologists have made to our advance. I hope it will continue. I do not know how many million years it took nature to store these small supplies of liquid and solid mineral fuel which we use at such an amazing rate, but I am informed that a few more hundred years will see the end of these supplies, so that to-day's temporary surplus is sure to become the shortage of to-morrow. The work of the petroleum technologist, therefore, in conserving, economising and putting to the best use our liquid fuel supplies, becomes annually more important, and the responsibilities of the Institution of Petroleum Technologists become annually more great. On behalf of aviation, on behalf of all internal combustion engine users, and on behalf of the users of the white products of petroleum in general, very sincerely I thank you (Applause).

"The Institution of Petroleum Technologists."

Sir Robert Waley Cohen, K.B.E., who was received with applause on rising to propose the toast, said: I rise with very great pleasure to give you this toast. I remember some thirty years ago, when I first entered the petroleum industry, this Institution had not been formed, and the number of petroleum technologists could, I think, almost be counted on the fingers of one's hand. When you think of the extent to which this great profession has grown, and see this splendid company here to-night, I am sure everyone will realise that they are not, perhaps, in special need of our good wishes to maintain themselves in very good health indeed.

We are, however, in difficult times, and it may be a good thing to remind ourselves just now that, however hard the times are, perhaps the most important thing we can do in these difficult times

is to maintain our technology going ahead as fast as possible (cheers).

In those days, thirty years ago, Mr. Fairey has told you that all that you were asked to do was to smell a petroleum, and that was the extent of the technological examination that was made of it. I think he exaggerated. I remember when we were also told about the colour; in fact, I remember a committee being set up, when we were trying to be very scientific, to try to stabilise the nomenclature according to colour. They produced a product which had approximately the colour of sherry and suggested it should be called "water white" (laughter). I think, therefore, it was well done to found an institution which is less liable to pander to the prejudices of the business side of the industry and less tempted to give technical names that were not really quite suited to the products to which they were given.

The progress which has been made reminds me of how, at the age of about 23, when I was a young employee in one of the companies, I was allowed, after much trepidation, to submit a sample of a petroleum distillate to a chemist. He would not call himself a technologist in those days; he was a pure chemist (laughter). I was allowed to ask him to analyse this product. We all felt very safe, because for a long time the industry had been accustomed to ask for analyses of petroleum, and all that happened was that it was put into a flask, and you were told some temperatures at which some parts of it boiled and you were told its smell and its colour, not always in very illuminating terms. This was, I think, the first occasion on which a scientific chemical analysis was made of a petroleum distillate. It was submitted to a young man named H. O. Jones, at Cambridge. He afterwards became a Reader in the University and sat as a member of the famous Royal Commission on the supply of fuel to the Navy. In the course of his experiments he found some aromatic hydrocarbons, and I think was the first to announce that aromatic hydrocarbons were found in large quantities in nature in the form of petroleum. That experiment was really the foundation of the ideas which have grown to such extraordinarily important dimensions, and which are suggested to us now by the whole of the anti-knock science in the use of petroleum products in internal combustion engines.

That experiment had another rather interesting economic consequence, namely, that a petrol which at that time was called inferior and which was being sold at a discount of 25 per cent., immediately became superior and was sold at a premium of 10 per cent. (laughter), so that the economic consequences of the first really scientific work that was done upon petroleum products were very great indeed.

I am sure no one will question that the progress which has been made since then has been very largely due to the work of the Institution of Petroleum Technologists and its enthusiasm for really scientific work. The progress which we have made since those days owes a very great deal to the petroleum technologists.

However, Mr. Fairey has said that he has not much use for you in the future; he thinks you have almost achieved your purpose (laughter). There may be a little to be said for that view if you are to confine petroleum in the future to the purposes to which it has been restricted in the past, namely, burning it up. The fact remains that to this day 99 per cent. of these immensely complicated chemical substances that occur in the petroleums of the world are used for the somewhat elementary purpose of securing the energy of combustion by turning them into water and carbonic acid gas. That is surely a very early stage in the work of the petroleum technologist, and I hope you will pass very soon from the uses that Mr. Fairey has for you and that you will feel that our product is entitled to a higher use in the service of mankind.

We may discern something of it in the rather despised experiments on hydrogenation. I do not mean the hydrogenation of coal; I agree that that is a subject which does not interest this company very much, and rightly not. The hydrogenation of oil, at any rate, is an effort to introduce a new and what you might call a constructive element in the petroleum molecule rather than to confine ourselves merely to its destructive combustion.

I remember Mr. Jones, in those famous experiments he carried out, showing me 350 pure chemical compounds which he had isolated from that single distillate of crude petroleum. When you reflect that that was something like thirty years ago, we cannot congratulate ourselves very much on the use we have made of those 350 pure chemical substances.

I expect that most people in this room have listened to or read that stimulating address by General Smuts which so much delighted the scientific world a few weeks ago. He warned us that the barriers which had been set up between the sciences of animate objects and the sciences of inanimate objects and the sciences of the mind are artificial, and that we have a great deal to learn by applying the methods of one to the problems of the other.

I remember that in those early days there was a subject called physiological chemistry, in which the human machine was regarded chemically very much as a combustion chamber in which proteids and fats and hydrocarbons were burned up into carbonic acid and water, just as fuel is to-day. There grew out of that, however, the science of biochemistry, and when you reflect what progress that science has made in the last five years and how differently we

can now look at the whole process of life, I am sure there is no one here who need despair of applying new ideas and new methods to the scientific and chemical examination and use of petroleum and its products (cheers). I do not think, looking at it over a long period of years, that the technologists have very much time to waste, because I think we must all be impressed with the way in which physical science has demonstrated the enormous sources of energy by which we are surrounded in every-day life, and which if we could only tap them would make oil and coal, if I may say so, look silly. Electrical energy undoubtedly surrounds us in enormous quantities. If ever the human race discovers—as I am sure it will, and not too far ahead—how to tap those enormous sources of energy, which are far more universally distributed and far more accessible in reality than either oil or coal, then we shall be too late if we have not discovered a better use to make of our fine chemical compounds in the oil products.

So much for the chemist. I think we may feel that he has his work cut out, and I hope there is no chemist here, whether at the beginning of his career or towards the end of it, who is not determined to see the petroleum industry occupied with services to mankind of a far higher nature then merely the supplying of petroleum to burn to supply energy.

With regard to the geologist, he has, perhaps, gone a little too fast for us recently (laughter). He has made it less difficult to find oil than it ought to be (laughter), with the result that, owing to the sluggishness of the chemist, we do not quite know what to do with it all at present. He too, however, will have to keep pace with the progress which I am sure we shall see in the chemical world. One who follows the increased knowledge which has been acquired only in the last five years of the problems of terrestrial evolution must realise that the geologist, too, is going to have a new vista opened out to him before long, and if the petroleum industry is not to be carried right off its feet he must make a good deal of progress between now and that time.

There remains only one task which I ought to mention, and it is perhaps the most important task of the petroleum technologist —namely, that of educating and carrying with him the business man. I am going to have the pleasure of associating with this toast our President, Mr. Kewley. (Applause.) Notwithstanding the unbounded admiration which I think we all feel for his work as a technologist and for his large vision as a scientific man, I, who worked with him as a business man for a good many years, always felt that one of the things he did most skilfully was to manage the business man; and I feel entitled in his presence to say to you all here that that is a task which should never be

neglected. If that task is carried out, and if, in addition to keeping in touch with the practical problems of the industry, the petroleum technologists keep touch, as they must, with the progress of pure science, then I am sure we need have no fear for the future of the petroleum industry. In my time I have seen it develop one new activity after another, and my firm conviction is that its future will rival its past.

I therefore have the greatest possible pleasure in asking you to drink the health of the Institution of Petroleum Technologists, coupling with it the name of the President, Mr. Kewley. (Applause.)

The toast was received with enthusiasm.

The President of the Institution (Mr. James Kewley), who received an ovation on rising to reply, said: Before replying to this toast, I feel I must thank you, Sir Robert Waley Cohen and Sir John Cadman for the remarks you have made about myself, quite undeserved though I think they are.

Agricola, in the year 1580, in his famous book "De Re Metallica," wrote: "A miner should be a good and serious man, and should not make use of an enchanted twig; . . . he should follow the natural indications which he can see for himself and dig." It seems very strange that to-day the science of geophysics has not yet completely displaced the practice of rhabdomancy. Only last year a man came to me and in all seriousness suggested that he should divine for oil. There are those who make practical use of the enchanted twig to-day, but there are many others who make a metaphorical use of this enchanted twig. Superstition dies hard. The mascots on our motor-cars suggest the dying embers of fervid ancestral faiths.

I raise this subject of superstition because this happens to be our Thirteenth Annual Dinner, it is being held on a Friday, and there are thirteen items on the musical programme. (Laughter.) The fact that we have no fewer than 193 people at this dinner to-night, which is only about 20 less than our record, shows that petroleum technologists, at any rate, have taken to heart the advice of Agricola.

We have heard something about the depression from which we are suffering. I am not going to emphasise that, but I do wish to emphasise that a period of depression is no time for a period of mental depression or inactivity. It is my duty to show you that the Institution of Petroleum Technologists has not been undergoing a period of inactivity or mental depression, and I think I can best illustrate that by reciting to you a few of the developments which have taken place during the past year. I quite agree that the proper place to do this is really the Annual General Meeting, but as that is a function which so few of you attend (laughter), perhaps I may trespass on your patience now.

A very important event, indeed, has taken place during the last year. Sir John Cadman has referred to the early petroleum users at the Tower of Babel. I am afraid I do not know my Bible well enough to be quite certain whether that eminent naval architect Noah was prior to the Tower of Babel or later, but at any rate he was a very famous user of petroleum. Nebuchadnezzar, that famous builder of roads, was also a pioneer in the art which one of our guests here represents to-night. In recent years several intrepid lady users of a certain petroleum product have done great deeds which must command our admiration. Although the advent of ladies among the users of petroleum is comparatively recent, there were lady pioneers in the production of crude oil long ago. There is an old legend in Burma that about two thousand years ago a certain King, one Alaungsithu, accompanied by his seven wives, made a tour throughout his province, and happened to call at a spot, now well known to all oil men, Yenangyaung. While there he gave his seven wives permission to take a stroll through the jungle, and appointed a definite time for their return. These good ladies, in their wanderings through the forest, came across a pit of fragrant smelling earth, which naturally engrossed their attention with the inevitable result that they arrived home late. Their irate King and lord, very indignant that his seven wives should have preferred this fragrant earth to the company of their lord and master, decreed that they should die. They, poor things, in their despair, said: "Let this scented earth lose its fragrance and become an ever-flowing stream of foul smelling oil, and let those who collect it pay us honour as their protecting deities."

Gentlemen, the first lady petroleum technologist is here with us to-night. (Applause.) We welcome her to our festive board and we admire her pluck in joining us here. (Applause.)

Apart from this outstanding innovation, our activities have extended in various directions. Our membership shows a steady increase; the access of fifty new members this year brings our total up to 1274. We have 159 members in Asia, 136 on the Continent of Europe, 90 in the United States, 27 in Africa and even 10 in Australia. Our branches—South Wales, Persia, Rumania and Trinidad—hold regular meetings and are doing excellent work and contribute good material to our Journal.

Our Journal, of course, speaks for itself. It is well known all over the world and held in high esteem. It now appears in twelve monthly instalments, and in that way speaks not only for itself but for the very active work which our Honorary Editor, Dr. A. E. Dunstan, puts into it. (Applause.) It must be a very great source of satisfaction to Dr. Dunstan to realise that the aim he set himself many years ago has now been realised.

The action of Dr. Dunstan also recalls the attitude of all our Past-Presidents, who do not, after a couple of years' strenuous work in the Presidential Chair, lose their interest in the Institution. Dr. Dunstan has resumed the active editorship of the Journal and, as you know, Professor J. S. S. Brame is still the active Chairman of our Standardization Committee and Mr. Alfred C. Adams our trusty Chancellor of the Exchequer. (Applause.)

We have extended our activities in the last year in the direction of forming various sub-committees to deal with certain important problems. Sir Robert Waley Cohen has emphasised the importance of knock-rating. We have set up a committee to deal with this, and we have established a working co-operation with a similar committee in America, and are also well on the way to establishing co-operation with a committee in Germany. The existence of this trinity gives us, I think, every right to hope and to expect that before very long we shall have international agreement on this important subject.

We have also set up recently a committee to deal with weights and measures and the measurement of oil in bulk. Their preliminary investigations have disclosed a considerable amount of confusion. It is their intention to issue a booklet on the subject, which we hope will be backed up by the various standardizing committees in the different countries. We trust this will fill a real want and be accepted as a standard work.

In this connection, I must deplore the sad death of our Vice-President, Mr. Robert Redwood, who was particularly interested in this work of the Weights and Measures Committee and who worked with us until a few weeks of his death. His kindly presence at our Council meetings will be sadly missed.

We have also set up a committee to deal with the subject of mule spinners' cancer, which is receiving a good deal of attention at the present time, so that those who are carrying out the pathological research may have the benefit of close association with chemists who really know something about lubricating oils, their chemistry and manufacture, and who can speak authoritatively on this subject, for we feel that without the co-operation of such men the interpretation of the results would be difficult and might be misleading.

A point of paramount importance to-day is, of course, finance. That is very ably dealt with by Mr. Adams. I can assure you that our budget does balance this year, and we have every reason to hope it will balance next year also.

I must at this point also say something of the activities of our Honorary Secretary, Mr. Arthur W. Eastlake, who guides us in all these matters of detailed procedure, which he has made his

special province. I must also refer to Commander R. E. Stokes-Rees, R.N., our Secretary, to our Associate Editor, Mr. George Sell, and the office staff generally. (Applause.)

I should also like to draw your attention once more to the existence of the Benevolent Fund. These are hard times, and our Benevolent Fund, small though it be, is actually proving useful to many people in distress. We have made four definite grants during the last year. The total capital of our Benevolent Fund so far only amounts to about £300, or rather less, so that we are living on our capital. I should like to make an appeal to you all to do what little you can to build up a capital sum, so that we may get our Benevolent Fund on the sound basis of living on its income rather than on its capital.

With regard to the future, we are a comparatively young Institution, and we feel that we have a future of ever-expanding activity. We have heard something to-night about the world's production of crude oil and the possibility of its exhaustion. If you take the figure of 200,000,000 tons a year, which is the present production of crude oil, judged by ordinary human standards it seems a large figure; but that is not the right way to look at it. The total quantity of oil extracted from the earth since the date of the boring of the Drake well does not yet amount to a cubic mile. A considerably larger volume of material was blown out of the earth at one blast by the eruption of the volcano Krakatoa.

If we think of it in that sense, we must realise the potentialities of the future production of petroleum are great indeed. But, even if there were no crude oil, it does not follow that the activities of the petroleum technologist are going to end. Our founders were very far-seeing men; one might almost think they went so far as to foreshadow the developments about which Sir Robert has spoken. Whether they did so or not, they certainly gave us a very broad definition of the word "petroleum"; they defined it in such a way as to include not only the oils they knew but also the various synthetic hydrogenated oils, polymerised oils and so on which we are beginning to know. We have therefore ample scope.

They also laid it down—as you will see if you read our Articles of Association—that one of the objects of the Institution was to accumulate knowledge. Unfortunately they did not specify what we were to do with the knowledge when we had accumulated it, but we will assume they intended us to disseminate this knowledge. We can do that in two obvious ways: one is by our Journal, to which I have already referred, and the other is by expanding the functions of our library. This has been explained before, so I need only say that, with the active help of our Librarian, Miss

Clare Despard, working together with a newly constituted Library Committee, I think the development of our library in the direction of an information bureau which will be of real use will proceed rapidly.

But there are other directions in which our Institution can be of great use to the industry as a whole. I have referred already to the stranglehold which superstition seems to have on the human race at the present time. There are, however, other evil influences —prejudice, tradition and fashion—which still hold the world in thrall. To fashion most of us are still willing slaves. I think fashion evidences itself as a tendency to accept new ideas too readily, without criticism or before they have been confirmed. We in the petroleum industry are not faced with the kaleidoscopic changes characteristic of ladies' dress, but we must nevertheless beware. There are already pink and blue gasolines on the market. It is all the rage nowadays to talk about octane numbers, viscosity indices and so on.

Tradition, on the other hand, evinces itself by a tendency to accept ideas without criticism simply because they have acquired a certain amount of respectability through long usage. The effect of tradition and prejudice is to stabilise fashion, to freeze, if you like, the fluidity of milliners' creations into the solid rigidity of man's attire. Such established fashions die hard. The old idea that petrol could be judged by its specific gravity has not yet been completely exterminated; many people still think you can judge the quality of a kerosine by its colour and of a lubricating oil by its bloom, and doubtless the geologists and engineers could furnish us with similar examples.

One of the things our Institution can do is to exterminate these evil influences. We can do that by education; in fact, this was one of the behests of our founders. Now, the education of the public is a difficult matter. The failure of the British Broadcasting Co. in the matter of the prevention of litter and the extermination of our wild flora is a sad example. The education of the business man is apparently not quite such a difficult thing as I had thought. (Laughter.) We can certainly educate our students, who are potential petroleum technologists.

Our students are quite an active body. They have two centres at present, Birmingham and London, and they both hold regular meetings. I should like to suggest that some of our senior members should give a little more attention to the students by attending their meetings, giving them lectures and so on. A few words of encouragement are a wonderful stimulus. Encouragement is so simple and costs so little to the donor that we do not realise, perhaps, what a wonderful gift we have in our power to bestow.

In this connection I must thank Mr. Ashley Carter for the great interest he has always displayed in the Students' Section.

Many of our guests here to-night are representatives of great users of petroleum. The Institution, perhaps, can do something for them. Our motto, *Conjunctione potiores*, "By co-operation we are the stronger," suggests a way in which we can help. Take, for example, the automobile industry. The automobile industry and the petroleum industry both have common users; their interests are the same. The efficiency of the engine is related to the fuel, and *vice versa*, and yet those two industries have so far gone on developing with little or no co-operation. There is, I hope, a definite opening for us here to do something to bring about some organisation for studying the two problems together. A trend in this direction is indicated by the joint meetings which are now often arranged.

I am taking, perhaps, rather a long view when I express the feeling that the future happiness of the human race depends largely on co-operation. Ever since life came into being Nature has worked on the law of competition, but Nature's highest achievement, Man, is doing a great deal to reverse the action of Nature's law. I think the future of our race, taking the long view, will depend less and less on competition and more and more on the scientific control of conditions, which can be arrived at by close and willing co-operation. Modern civilisation can only proceed on these lines. We must be abreast of the times. If we can do anything to assist in the furtherance of this desideratum we shall at least have done our bit. (Prolonged applause.)

"Our Guests."

Mr. A. Beeby Thompson, O.B.E. (Vice-President), in proposing this toast, said: To me has been entrusted the pleasing duty of proposing the health of our guests, and on behalf of the Institution I extend to all the heartiest of welcomes. As on former occasions, we are again honoured by the presence of many distinguished members of the Defence Forces and Civil Service, eminent scientists representing our learned Societies and well-known leaders of industry.

Many of our guests and visitors are far more concerned with the utilisation of petroleum than with its production in the field and its treatment in the refinery, and doubtless this part of the industry interests them most. Possibly some of our guests wonder what a petroleum technologist actually is. I would suggest that he might quite appropriately be defined as the evolutionary product of the petroleum expert, a mysterious individual who at one time was

expected to know everything about oil and to be able to advise on all branches of the oil industry, prospecting, drilling, raising of oil, refining, storage and distribution. To-day few petroleum technologists aspire to more than a general knowledge of one or two of the many branches into which the industry is divided. They include surveyors, geologists (including specialists in stratigraphy, palæontology), geophysicists, engineers and lastly chemists, the latter constituting such a large and illustrous proportion of our members.

Not many years ago the few who could claim the distinction of being petroleum technologists were in great demand, but, shortly before the war, British and American Universities and Colleges, at the instigation of the oil companies, set out to train students for a petroleum career. The results have been striking. Perhaps the romance of oil attracted a more than usually enterprising and adventurous class than did more prosaic professions; but, whatever the cause, the new blood got busy and by liaison work with the great manufacturing interests advanced oilfield technique at such a pace that the world is now glutted with unwanted oil.

It is, perhaps, only fair to say that no one class of technologists can be held responsible for this state of affairs, for geologists, geophysicists, engineers and chemists helped to bring about the conditions, which are as distressing to the industry at large as to the many disengaged specialists who did so much of the hard spade-work, under very much more trying field conditions than exist to-day.

I imagine that some of our guests from other Institutions regard us with a certain amount of suspicion, for, not content with releasing the flood of natural oil, our chemical associates have sinister designs on the coalfields. We have heard a good deal about the efforts to convert coal by the hydrogenation process, and, though it is a long way from achieving any form of success at the moment, it is something which has to be kept in mind. Oil men have already captured the gas industry in some countries and they control the carbon black and, very largely, the sulphur industries. In France they are adding considerable quantities of alcohol to their spirit, and the day may come when we shall add whiskey to our spirit on this side. (Laughter.) In this connection I should like to refer to an amusing incident which occurred many years ago in Peru, when our chemist there recorded the isolation of alcohol in the oil. The principal in London, who was a Scotsman, said he did not believe it, because, he said, "We have had a Scotsman as manager of that refinery for twenty years, and if the oil had contained any alcohol he would have discovered it years ago." (Laughter.)

The oil industry is in trouble, like many others, but it is certainly not suffering from lack of technical skill, but from economic causes which are world-wide, and it is to the economists rather than to the technologists that we look for relief. A solution of the over-supply problem should not be beyond the powers of the brilliant executive officers who control the destinies of our oil companies.

We have with us to-night distinguished representatives of the Navy, Army and Air Force. Science and industry are well represented, as well as research, standardization, and road, ocean and air transport. The presence here to-night of these gentlemen implies a recognition of the importance of petroleum in all branches of life, and surely we may be forgiven a feeling of pride at holding the speed records on water, land, and air, all of which depended upon petroleum for fuel and British pluck and endurance for their consummation. (Applause.) Such results cannot fail to stimulate high speed travel and, what is more important, cause greater calls on the industry for oil.

Knowing their interest in oil, and consequently in our Institution, we cordially greet Air-Marshal Dowding, Major-General Peck, Mr. C. R. Fairey, and Mr. Handley Page, whose name is a household word. We are also pleased to have with us Engineer Vice-Admiral Sir Reginald Skelton, who has already spoken, and we feel sure that he will burn every drop of fuel oil released by the Admiralty! Unfortunately, all the efforts that are made to-day are in the direction of economising oil, and when one looks back to war-time and remembers the scenes at a place like Salonica, where hundreds of cars were used to serve the Serbian front lines, all using petrol at an enormous rate, one almost envies those days!

We also welcome Dr. G. T. Morgan, President of the Society of Chemical Industry. Most of our great oil-producing companies are strongly represented to-night, but they are all such liberal supporters of our Institution that we almost regard them as part of ourselves. They include such well-known men as Sir John Cadman, Sir Robert Waley Cohen, Mr. Heath Eves, Mr. Beaumont and Mr. Dalley. We also have with us Mr. Hittinger and Mr. Halls and Mr. Calder.

Other guests to whom we extend our welcome are Colonel Bressey, Mr. Le Maistre, Mr. Starling, and Mr. Bristow.

I should also like to record our pleasure at having with us Mr. Homer Fox. (Applause.)

Nor must I omit to remind you of the presence of our friends the press, who so loyally record our proceedings and advertise and popularise the products of our efforts, sometimes without, but occasionally on payment. (Laughter.) We are also delighted to see again Mr. Fred May, who annually dispenses pleasure by

cleverly magnifying those physical peculiarities some of us take such pains to conceal.

I ask you, therefore, to drink to the health of our guests, and I couple with the toast the name of that great pioneer of commercial aviation, Mr. Handley Page. (Applause.)

The toast was cordially received.

Mr. F. Handley Page, C.B.E., who was received with applause on rising to respond, said: I was somewhat terrified, seeing that I was on the list to reply for the guests, when I heard that this was the thirteenth occasion on which you had met. I am not sure whether it is the first one who rises—Sir John Cadman—or myself who meets the inevitable fate of those who rise on the thirteenth occasion, but I am sure that if it is Sir John Cadman he will rise again. (Laughter.)

It is a very great pleasure for me to be here this evening, because I can speak with complete impartiality on the subject of coal versus oil, since I happen to be a Vice-President of the Gliding Association. (Loud laughter.) When I listened to Sir John Cadman I began to hope that I was going to hear an interesting and eloquent address on the Bible and oil, Elija and Elisha and the first case of spontaneous combustion—(laughter); and, more important, I hoped he would deal with Moses standing in front of the burning bush, where he took his shoes off. I believe that since the pirates have come into the oil business you are very lucky if you get away with your shirt on. (Laughter.)

It is a great pleasure for all your guests to be present this evening, because if one reviews what oil has done one finds it has played a very great part in the history of mankind, and oil has become synonymous with something which gets rid of all the difficulties of mankind. In saying that I am not referring to those qualities which have been so eloquently referred to by previous speakers, but to such phrases as "pouring oil on troubled waters," and to what was said of the Good Samaritan, who "poured in oil and wine." Those are all eloquent of what the world associated in the past and associates to-day with the good name of oil.

I speak as one who is interested in an industry that is rather the opposite of the great oil industry. In commercial air lines it is impossible to carry on without a Government subsidy. They call it a subsidy, but we say it is advancing the civilisation of the world, bringing together the portions of our far-flung British Empire, and a hundred and one other things which we use in an endeavour, more or less successful, to get more money out of a hard-hearted Treasury. (Laughter.) That is where we differ from the oil industry, because you, in common, I believe, with beer, are one of the great liquids of the world by which we are relieved of income

tax. (Laughter.) I am, therefore, very pleased to be here this evening, because I feel I am among those who make possible the aviation industry of to-day, because the money the Government take from you they hand over to us by way of a subsidy—(laughter), for a very much greater purpose and a very much greater end.

Quite apart from that, it is a pleasure to be amongst those who represent the scientific development of oil, for, as Mr. Fairey said, without oil aviation would not be what it is to-day. It is all very well to talk of coal and steam and so on, and of the industrial revolution which came from the introduction of the steam engine, but coal had to have used with it that tax-free product, water, in order to give power in some form for industry to use ; but you are able, in the very concentrated form of fuel oil, to offer us a medium from which we can get our energy more cheaply, efficiently and cleanly ; and without that form of energy aviation would not be possible to-day. It is, therefore, a very great pleasure for anybody associated with aviation to be amongst those who are responsible for the advancement of this science.

I do not share the great depression which apparently reigns amongst everybody connected with the oil industry. It seems to me that those of you who are responsible for such volatile spirits will surely be able to rise above the present clouds (laughter) and show us once more new outlets for oil, new ways in which this energy can be used in order to rise once more to enormous production and get on the top of the wave.

The greatest pleasure of all, however, is in relation to that question of income tax on which I have already touched. I look around and see you all, and I only wish you were twice as many, so that the income tax might be halved. (Laughter.) I feel I would almost like to be on the other side and be one of those who are suffering from depression ; in fact, I should be quite prepared to leave this country and go to India and be one of the depressed classes, if in fact that would carry with it what to me is an essential quality, namely, that I should be one of the Untouchables. (Loud laughter.) I have never been able to understand why people should be Depressed who are Untouchable. (Laughter.) It seems to me a perfect contradiction in terms!

Therefore, gentlemen, it is a double pleasure—double because of the scientific side of it and because of the side to which I have just referred—to me to be present here this evening, and I thank you very much for the opportunity you have given me of replying to this toast. I should like very much, on behalf of all the guests present to-night, to thank Mr. Beeby Thompson for the kind way in which he proposed the toast and you, gentlemen, for the way in which you have received it. (Applause.)

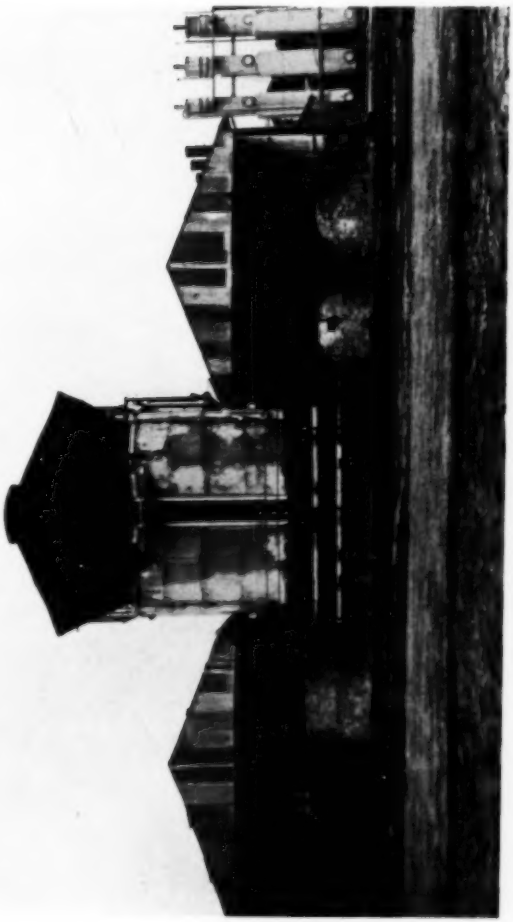

FIG. 1.
ALANMOR STOVES. END ELEVATION.

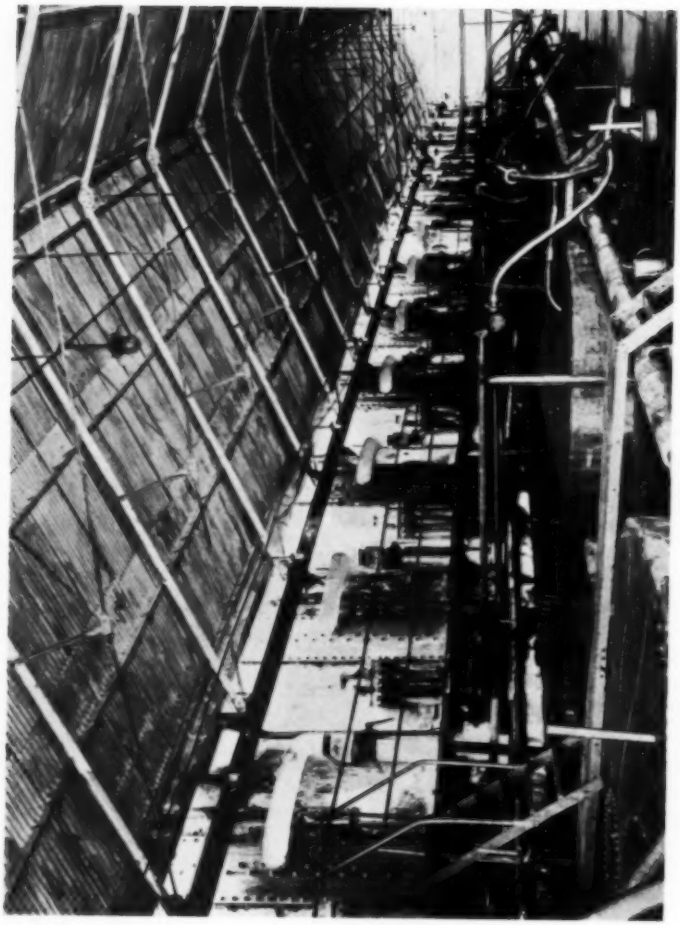

Fig. 2.

ALANMOR STOVES. SIDE VIEW AND RECEIVERS FOR PRODUCTS.

UNIV. OF MICH.

THE INSTITUTION OF PETROLEUM TECHNOLOGISTS.

THE ONE HUNDRED AND THIRTY-SEVENTH GENERAL MEETING of the Institution of Petroleum Technologists was held on Tuesday, October 13th, 1931, at the House of the Royal Society of Arts, John Street, Adelphi, London, the Chair being taken by the President, Mr. J. KEWLEY.

THE SECRETARY read the list of candidates nominated for election and the following list of members elected :—

As Members.—Edward Rogers Cartwright, Albert Matsell, Thomas Albert George Stredwick, Thomas Fulton Williamson.

As Transference to Associate Member.—Ronald Broadhurst.

As Students.—Bertrand Dexter Bailey, Raymond Harry Keach, Patrick Beverley Maples Linton, Frank Mayo.

THE SECRETARY also announced that nominations for Council should be in his hands not later than November 30th, 1931.

THE PRESIDENT, in introducing Mr. H. L. Allan, remarked that Mr. Allan was the manager of the Burmah Oil Company's plant at Syriam, Rangoon.

The following paper was then read :—

Apparatus for the Sweating of Paraffin Wax

By H. L. ALLAN.

THE appliances or machinery for the sweating of paraffin scale to produce refined wax have not been fundamentally improved until recently, since Norman Henderson invented and patented the Henderson stove half a century ago.

The Henderson stove represented a very great advance on the sweating appliances then in use and effected large economies in labour and fuel. This paper deals with sweating only, chemical or other treatment before or after is not discussed.

Prior to the advent of the Henderson stove, the methods of treating paraffin scale had advanced through several stages. In Scotland, in the Shale Oil industry, the crude paraffin scale was diluted with naphtha and moulded into cakes ; these were pressed, expelling oil and soft paraffin dissolved in the naphtha. This process was repeated until the purity desired was obtained.

Sweating was introduced by Hodges, of Price's Patent Candle Co., Ltd., who, it is understood, observed solid scale lying on the ground exposed to the sun gradually becoming whiter. He moulded cakes of scale, placed them on racks covered with matting, and heated the chamber in which the racks were housed until

ALANSON STOVES. SIDE VIEW AND RECEIVERS FOR PRODUCTS.

the desired degree of purity was obtained. Hodges patented his sweating system in 1871. It was the practice for a long time after to add naphtha to the scale before moulding into cakes, as the naphtha assisted the sweating, presumably by dilution of impurities which hindered good crystallisation.

As the technique of oil refining improved, the use of naphtha was gradually eliminated, although one occasionally finds samples of white wax which have obviously had the assistance of naphtha or light spirit in refining.

Sweating cakes on racks did not produce a uniform quality, as the colour of the finished cakes lacked uniformity. Hence the work of discharging the wax from rack stoves by hand was increased by the fact that selection had to be made at the same time to produce a product which could be efficiently and economically bleached by subsequent treatment. The reason for this lack of uniformity can be easily traced to the method of moulding the cakes. The moulds were air cooled in buildings of considerable area, and the temperature variations and the rate of circulation of air, in addition to the manner of filling the moulds, all contributed to establishing differing physical conditions in the moulded cakes. Cakes weighed about 10 lb., and the dimensions of the mould or tray were 24 in. × 12 in. × 2 in. In filling, the trays were on racks, and so arranged that when the top tray was full the wax overflowed through a slot on the end of the tray to the tray below and so on to the bottom tray. Usually 10 to 12 trays were so piled in a section. These racks of trays were fed from an overhead pipe, or more often a wooden gutter, in which were holes opposite each vertical series of 10 or 12 trays, the flow being controlled by a wooden plug. Spillage was excessive and cakes varied in thickness.

Paraffin entered the lower tray at a much lower temperature than the top tray, and by the natural circulation of air was also more quickly cooled. Obviously the manner in which the wax crystallized varied considerably, and this fact, together with the difficulty of getting absolutely uniform heating in the sweating stove, rendered it impossible to turn out each and every cake of maximum colour quality.

The Henderson stove, Fig. 1, was a great advance on this old method of sweating, and gradually developed to the deep pan type of apparatus used to-day by the major portion of the industry. The great technical advantage of the Henderson stove was the increase in the mass of the cake, allowing greater uniformity of cooling and sweating. The reduction in labour and fuel, the reduction in area of site required and in the buildings accommodating the plant, were economical advantages. The stove consisted of

a number of trays, usually 10 or 12, about 30 ft. long, 6 ft. in breadth and, say, 8 in. deep, containing in each tray a false bottom of wire gauze about 2 in. from the actual bottom.

These trays were carried on a steel framework and supported at several points to avoid sagging, and the whole structure could be tilted by elevating screws placed at one end of this carriage.

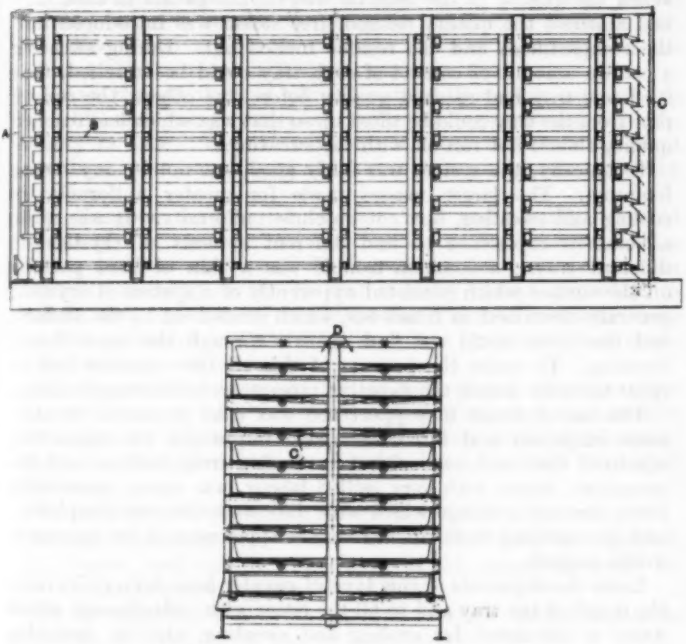

FIG. 1.

HENDERSON STOVE.

A Steam Header. C Rundown Pipes
B Steam Pipe. D Trays.

The whole was accommodated in a masonry building suitably lagged and fitted with steam or water heating grids ; air circulation was promoted by suitable ventilation and later by artificial or mechanical circulation.

The method of operation was to bring the trays parallel with the floor by means of the screws, fill up the trays to the gauze level with water and then with the liquid crude paraffin scale.

The wax in the trays was gradually cooled by the circulating air and, a later development, by circulation of water through coils placed in the wax space. When cooling was complete the apparatus was tilted to run off the water, leaving the paraffin as a solid cake supported by the gauze. The temperature of the compartment was then raised by the means described and sweating proceeded. When the quality of the residual wax on the gauzes in each tray had attained the quality desired, free steam was introduced into the compartment and the residue melted out. During sweating a certain amount of control of each tray could be exercised, that is, if one tray had reached quality before the others, the run-off pipe from the tray could be tilted up so that wax which had reached quality should not run off with the sweatings.

Technically, the system was fairly good, but not by any means foolproof. The larger masses made for greater uniformity in cooling and sweating, but not absolute uniformity. It was quite a common experience to find different systems of crystals on different trays; a common trouble was a skin of hard paraffin on the surface which consisted apparently of a system of crystals, generally described as foliaceous, which exuded oil to the surface, and the latter could not find an exit through the mass during sweating. To assist the passage of this oil the operator had to spear the cake during the sweating process, so facilitating drainage.

The use of water to support the wax cake promoted troublesome emulsions and introduced solid impurities, the open tray admitted dust and was subject to cooling irregularities, and the apparatus, unless with very skilled labour, was messy, permitting losses through drainage which were difficult to recover completely, and also entailing more labour than the appearance of the apparatus would suggest.

Later developments in this type of sweater have been to increase the depth of the tray and to fill the latter with coils through which water is circulated for cooling and sweating, and by designing the bottoms of the trays so that water and sweatings can be drained off without the use of a tilting device. These developments have improved both operation and product.

Other types of apparatus are the tank sweater used in many American refineries, and the systems attributed to Von Groeling and to Henderson, in which the wax is cooled in the annular space between concentric tubes, the latter being cooled and heated in a tank or bath of water.

In the tank sweater the cooling is effected by circulation of water through tubes rising vertically through the mass, and is, I believe—I have no personal experience of the type—generally used as a means of separating somewhat roughly the oil from the

wax in very soft scales containing a large percentage of oil, and is not generally in use for making finished product. The concentric tube type I have experience of, and have found it cumbersome, slow and generally unsatisfactory. I have not dealt with all types, and many others are described and illustrated in literature on the subject.

This roughly was the position of sweating technology in the industry when it became necessary for my former colleague, Mr. Jas. Moore, and myself, to redesign the wax equipment of the Burmah Oil Company in Rangoon after the war.

I had the privilege of visiting several European refineries in 1913/14, and many American refineries (accompanied by Mr. Moore) in 1920. We did not see our ideal wax sweating plant anywhere; we saw many that were interesting but not very practical.

In Rangoon, because labour was cheap and plentiful, the old system of wax sweating had been carried on for some years after it was obsolete elsewhere. Fuel economy had not become an apparent necessity to the pre-war industry except, probably, in Galicia, and under these conditions the original Henderson stove for first treatment and the Rack and Cake system for final treatment had met our needs.

The apparatus known—to few as yet—as the Alanmor stove was developed to meet our needs, and it is in order to introduce this apparatus to your notice and to give an account of its advantages that your President, Mr. Kewley, has invited me to present this paper.

In designing this stove we wished to have :—

(*a*) An apparatus that would be foolproof even in unskilled hands, and one in which most of the operations could be controlled mechanically if desired;

(*b*) A completely enclosed apparatus to which foreign matter in air or water could not be introduced;

(*c*) Complete control of cooling and sweating throughout the mass, and particularly in regard to the surfaces of the masses of paraffin under treatment;

(*d*) Compactness, a plant occupying the minimum area of land and requiring minimum expenditure for buildings;

(*e*) A plant which would eliminate thermal losses, as far as is possible, profitably;

(*f*) A heat exchanger system, of closed type, giving maximum fuel economy and preventing corrosion;

(*g*) A plant requiring the minimum of labour and control;

(*h*) A plant producing the maximum results in quality and quantity in the minimum of time.

FIG. 2.

"ALANMOR" PATENT WAX SWEATING STOVE (CELL TYPE).

A Water Header.
B Steam Pipe.
C Water Cell.
D Air Vent.
E Wax Cell.
F Expanded Metal.
G Wax Inlet and Outlet.
H Part Outside Plan.
I Water Outlet.
J Part Plan of Wax Cell, showing Pins.
K Water Inlet.
L Part Plan of Water Cell, showing direction of flow
M Part Plan of Wax Cell, showing expanded metal with supports.

Our first effort was a stove, Fig. 2. This consists of a tank about 20 ft. in height and 12 ft. in diameter, filled with cooling cells in which the annular space for water is 1 in.; attached to these cells at 3 in. pitch are mild steel fins 5 in. deep. The cells are piled in the tank on top of each other and have the appearance of a pile of 12 ft. diameter combs—I refer to the curry comb used to groom horses—the spaces between fins (or the toothed bars of the comb) being occupied by the wax under treatment. The cells are each separately connected through the containing tank walls to the water-circulating system. There is a header rising vertically up the side of the tank which is common to all the cells. The paraffin is introduced through the header and spreads between all the cells until the stove is full. Cooling water is then circulated through the cells and cools the wax layer, assisted by the fins or teeth of the comb.

When cooling is complete the part of the charge in the header is run out, there being steam pipes therein to assist this operation, and when the header is clear hot water circulation in the cells is established and sweating begins.

Each cell on its upper side, that is, the side without the fins, has a wire gauze laid on studs to support the wax during sweating; the small amount of charge between the cell top and the gauze rapidly melts away when hot water is circulated, leaving a wax cake split up at 3 in. pitch by the fins and supported on the gauze.

Sweating proceeds until the quality and melting point desired are obtained, and then free steam is introduced to melt down the residual wax.

Units of this design have been operating in Rumania and Assam for five or six years, and are still in operation. In Burma these stoves were not so fortunate, as they suffered badly from corrosion. We knew, of course, that corrosion would be extreme, and we trusted to an electrolyte method of countering corrosion from the free oxygen in the water. As corrosion had advanced so far before we could introduce means of preventing it, we decided to endeavour to simplify the apparatus, to make it cheaper and of greater capacity in the same cubic space, and a much sounder engineering proposition. The result was the present Alanmor stove, Fig. 3, of which there is a large number in use in Burma, Assam, Rumania and the Dutch East Indies.

In the latest type the containing tank or cylinder is as before; in fact, the tanks which contained the cell type in Rangoon were used to construct the coil type. Inside the containing vessel there are seven compartments 30 in. in depth, each compartment containing fourteen horizontal coils of 3/4 in. pipe at 2 in. pitch. The disposition of these coils is of importance. You will note that

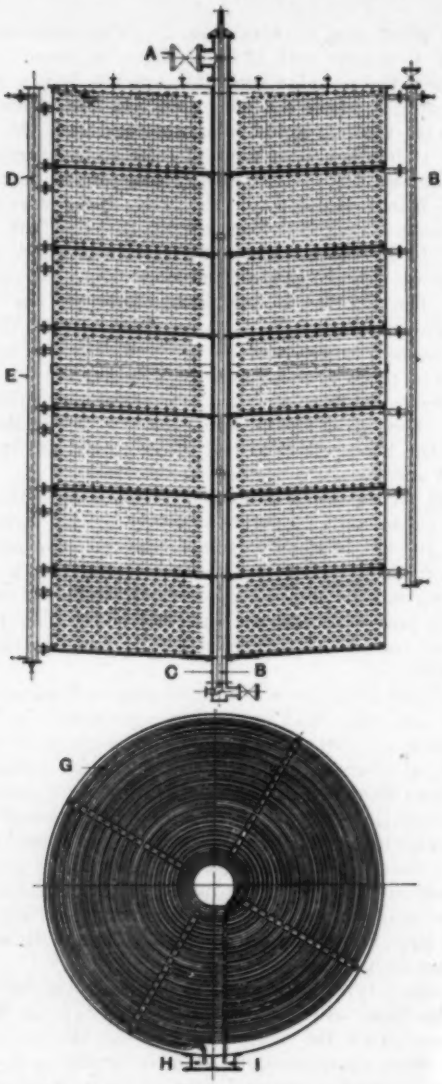

FIG. 3.

"ALANMOR" STOVE (COIL TYPE).

A Wax Inlet.
B Steam Pipe.
C Rundown Pipe.
D Internal Steam Pipe to keep Header clear.
E Open Steam for Melting Down Finished Wax.
F Air Inlet and Outlet.
G Coils.
H Inlet Header.
I Outlet Header.

ALANMOR STOVES.

Record of Runs Completed during 24 hrs. Ending 6 a.m. 26th December, 1930.

Stove No.	4	33	30	16	12	27	23	25	14	3	2	31	29	9	17	32	5
Run No.	556	78	477	588	612	463	669	483	583	517	576	228	449	585	580	207	545
Time of Starting.	8.0 a.m. 23rd	4.0 a.m. 24th	11.30 p.m. 23rd	5.0 p.m. 23rd	1.30 p.m. 23rd	5.0 a.m. 24th	6.0 a.m. 24th	9.0 a.m. 24th	1.0 a.m. 24th	8.0 p.m. 23rd	9.0 p.m. 23rd	1.0 p.m. 24th	5.0 p.m. 24th	4.0 a.m. 24th	12.0 noon. 24th	10.30 p.m. 24th	5.0 a.m. 24th
Time of Finish.	7.0 a.m. 25th	9.0 a.m. 25th	11.30 a.m. 25th	12 noon 25th	1.30 p.m. 25th	2.0 p.m. 25th	2.30 p.m. 25th	3.30 p.m. 25th	4.30 p.m. 25th	8.0 p.m. 25th	8.0 p.m. 25th	9.30 p.m. 25th	9.30 p.m. 25th	1.0 a.m. 26th	1.30 a.m. 26th	5.30 a.m. 26th	5.30 a.m. 26th
Total Time.	43½	29	31½	38½	46½	31½	27½	30½	37½	46	43	28½	28½	43	31½	29	48½
Intervals.	3½	—	4½	4½	1½	1½	5	—	2	2	4	4	—	2	6	2	—
Filling.	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½
Cooling.	19	21	15	19	19	24	19	19	19	19	19	19	15	19	19	19	19
Sweating 1st Cut.	8	6	13	10	7	4	3	5	9	8	7	3	10	7	5	5	10
Sweating M. Cut.	13	—	—	6	17	—	2	2	6	15	13	2	—	13	4	2	16
Melting out Product.	3	1½	3	3	3	3	3	4	3	3½	3½	4	3	3½	3	2½	3
Tint of Product.	15.0	4.5	1.25	11.0	17.0	4.5	1.5	1.5	11.0	19.0	14.0	1.5	1.75	12.0	3.5	1.5	16.0
M. Pt. of Product.	135½	112	111½	124½	140½	116	120	120½	124	139½	136	120	110½	135½	129	120	140
% age 1st Cut.	25	70	70	30	25	65	37	26	30	25	25	20	70	25	25	20	25
% age M. C.	35	—	—	20	40	—	18	29	20	40	35	30	—	35	30	35	40
% age of Product.	40	30	30	50	35	35	45	50	50	35	40	50	30	40	45	45	35
Nature of Product.	W. Wax.	Y. Wax.	Y. Wax.	W. Wax.	W. Wax.	Y. Wax.	Y. Wax.	Y. Wax.	W. Wax.	W. Wax.	W. Wax.	Y. Wax.	Y. Wax.	W. Wax.	W. Wax.	Y. Wax.	W. Wax.
M. Pt. of Charge.	129½	97	97½	120	132	101	114	114	120	131½	129	113½	97	129½	118	114	132
Nature of Charge.	MC&Y Wax.	S. S.	3rd Scale	LMPY Wax.	H. S.	*	S. S.	S. S.	LMPY Wax.	H. S.	MC&Y Wax.	S. S.	3rd Scale	MC&Y Wax.	1st Cut.	S. S.	H. S.

Cold Water Temperature at Stoves, 87° F.

Time in hours.
Tints in 500 Series (Y. Wax in ¼-inch cell and W. Wax in 12-inch cell).
* 1st Cut from Inter. Scale and HMP. 1st Cut.

S. S. Soft Scale.
H. S. Hard Scale.
M. C. Middle Cut.

UNIV. OF MICH.

ALANMOR STOVES.

Record of Runs Completed during 24 hrs. Ending 6 a.m. 29th December, 1930.

Stove No.	23	21	32	26	11	8	31	1	5	13	24	30	20	7	19	10	18	6	28
Run No.	670	654	208	541	602	632	229	615	546	629	588	479	567	557	589	687	559	642	608
Time of Starting.	11.0 a.m. 26th	5.30 p.m. 26th	9.30 p.m. 26th	1.0 a.m. 27th	3.30 p.m. 26th	5.0 p.m. 26th	9.0 p.m. 26th	5.30 p.m. 26th	1.0 p.m. 26th	9.0 p.m. 26th	7.0 a.m. 27th	12.30 p.m. 27th	10.30 a.m. 26th	4.0 a.m. 27th	11.30 a.m. 27th	11.30 p.m. 26th	9.0 a.m. 27th	8.0 a.m. 27th	3.0 p.m. 27th
Time of Finish.	10.0 a.m. 28th	10.0 a.m. 28th	11.0 a.m. 28th	11.0 a.m. 28th	2.0 p.m. 28th	2.0 p.m. 28th	2.0 p.m. 28th	4.30 p.m. 28th	4.30 p.m. 28th	4.30 p.m. 28th	5.0 p.m. 28th	6.30 p.m. 28th	9.30 p.m. 28th	10.0 p.m. 28th	10.30 p.m. 28th	2.0 a.m. 29th	2.0 a.m. 29th	6.0 a.m. 29th	6.0 a.m. 29th
Total Time.	35½	31½	28½	28½	40	44	28	42	49½	35½	31	28	34	40	34	48½	39	46	36
Intervals.	11½	9	9	8½	6½	1	13	5	2	8	3	2	1	2	1	2	2	—	3
Filling.	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½	½
Cooling.	19	19	19	19	19	19	19	19	19	19	19	15	19	19	19	19	19	19	24
Sweating 1st Cut.	10	7	4	3	11	8	3	7	9	7	6	3	6	8	5	9	9	7	9
Sweating M. Cut.	3	2	2	3	6½	13	2	12	17	6	2	7	5	10	6	17	7	16	—
Melting out Product.	3	3	3	3	3	3½	3½	3½	4	3	3½	2½	3½	2½	3½	3	3½	3½	2½
Tint of Product.	1.25	4.0	1.5	1.75	20.0	15.0	1.75	17.0	18.0	10.5	1.5	1.75	3.0	15.0	1.5	17.0	13.0	14.5	5.5
M. Pt. of Product.	121	127	121	118	124	135½	120	135½	140½	124½	120½	110	130	137	121	140½	123¾	139¾	115
% age 1st Cut.	25	55	20	25	30	25	40	25	25	30	30	40	32	25	29	25	30	25	65
% age M. C.	25	5	45	25	20	35	10	35	40	20	20	30	23	35	21	40	20	40	—
% age of Product.	50	40	35	50	50	40	50	40	35	50	50	30	45	40	50	35	50	35	35
Nature of Product.	Y. Wax.	Y. Wax.	Y. Wax.	Y. Wax.	W. Wax.	W. Wax.	Y. Wax.	W. Wax.	W. Wax.	W. Wax.	Y. Wax.	Y. Wax.	Y. Wax.	W. Wax.	Y. Wax.	W. Wax.	W. Wax.	W. Wax.	Y. Wax.
M. Pt. of Charge.	115	112¾	113¼	111	120½	130	114½	129¾	131½	119¾	114	98	119½	129½	114	131½	120	131¾	102
Nature of Charge.	S. S.	1st Cut.	S. S.	S. S.	LMPY Wax.	MC&Y Wax.	S. S.	MC&Y Wax.	H. S.	LMPY Wax.	S. S.	3rd Scale.	1st Cut.	MC&Y Wax.	S. S.	H. S.	LMPY Wax.	H. S.	*

Cold Water Temperature at Stoves. 85° F.

Time in hours.
Tints in 500 Series (Y. Wax. in ¼-inch cell and W. Wax. in 12-inch cell).
* 1st Cut from Inter. Scale and H.M.P. 1st Cut.

S. S. Soft Scale.
H. S. Hard Scale.
M. C. Middle Cut.

each coil is offset to the coil above and below so that when the mass of paraffin sits around the coils, it is held in four point suspension, which prevents undue sagging during sweating. In existing tubed pan sweaters the coils are vertically above one another, leaving an unsupported mass of paraffin between each nest of pipes to the depth of the mass of wax in the pan after the full charge has contracted in cooling. There is a vertical pipe through the centre of the stove used for charging and for the efflux of sweats and finished wax. This pipe is slotted flush with the upper side of each floor so as to admit the charge and allow the subsequent efflux of products. On the outside of the tank or stove there is a vertical header pipe—fitted with a half-inch internal steam pipe —communicating with the top of each compartment; this pipe serves to release the air displaced during charging and to admit air during cooling and sweating. The internal steam pipe controls the temperature of air admitted, and also keeps the overflow of the charge in the liquid state until it is drawn back into the stove during cooling. The other external pipe, fitted with internal steam pipe and communicating with each compartment—top and bottom—is for admission of free steam to melt the residual finished wax. Each floor sags naturally to the centre pipe and so effects perfect drainage. On the surface of each floor there is 1/4 in. mesh expanded metal supported on studs, giving about ½ in. clearance between the floor and the gauze as drainage space during sweating.

In some models there is a coil below the gauze, but this has been found in practice to be unnecessary. Sweating starts as soon as the central pipe has been cleared by its internal steam pipe and hot circulation is started. The coils have inlet and outlet to common headers which are *en bloc*. The ends of the coils are, in fact, welded into the shell of the apparatus, and to the outside are two channel irons forming the *en bloc* header, the inlet water being separated from the outlet by a division plate, and both are enclosed by a common cover plate. If the coils require cleaning, the cover plate is removed and the coils are cleared by high-pressure water or air. The whole apparatus is covered or lagged by 3 in. cork slabs and finished externally with cement. It is quite unnecessary, therefore, to enclose the stoves in a building. The stoves are usually mounted on a plinth in order to keep all receiving tanks above ground, but obviously if tanks are below ground or at a lower elevation the apparatus can be erected at working clearance above ground level.

The mode of operation is as follows :—

Water at a few degrees above the melting point of the charge is circulated, and the charge is admitted at the top of the stove

through the central pipe, the bottom valve of which is closed. The wax passes into each cell from the bottom upwards through the slots—on the floor level of each cell—in the central pipe ; the displaced air passes away through the common air header at the side. When the stove is full the water is lowered in temperature and cooling begins ; when the charge is sufficiently cooled, the bottom valve on the central pipe is opened and the contents cleared out : a little steam may be required on the internal steam pipe to effect this. At the same time the temperature of the circulating water is gradually raised and sweating begins, and is continued until the tests of the effluent indicate that the operation of sweating is completed. The run-off connection is then switched to finished wax receivers ; free steam is admitted at the bottom and top of each cell and the wax melted out. The stove is then ready to renew the cycle.

The following Table I. is a record of a performance of an Alanmor stove in a refinery with which the writer has no connection ; also a statement giving yields from an Alanmor plant compared with results obtained from a well-known make of pan sweater at the same refinery. The cost of the pan sweaters was 75 per cent. more than that of the Alanmor plant (plus Royalty).

Table II. gives figures from the Burmah Oil Company's plant :—

TABLE I.

	Alanmor Sweating Stove.		Pan Sweating Stove.	
	Hard.	Soft.	Hard.	Soft.
Intake..	45 tons	45 tons	23 tons	23 tons
Nett output percentage ..	38%	25%	35%	22%
Cycle time	45 hours	46 hours	78 hours	67 hours
Capacity per unity per month	275 tons	177 tons	73 tons	54 tons

Thus 4 Alanmor stoves = 13/15 pan stoves.

TABLE II.

Input per stove—42 tons.
Nett output percentage—40/50%.
Average cycle time—41 hours.
Capacity per unit per month—260 tons (average 190 tons).
Steam for melting and heating water—960 lb. per ton of finished wax.
Steam for heating tanks and lines—1060 lb. per ton of finished wax.
Water used—19,800 per galls. ton of finished wax.

You will note that the plant is compact. One plant of 30 stoves, capacity over 5000 tons finished wax per month, covers with all its tanks, heat exchangers and de-oxygenating plant an area of 200 ft. by 100 ft.

The heat exchangers are of the usual type and are introduced to prevent access of air to the circulating water and to economise

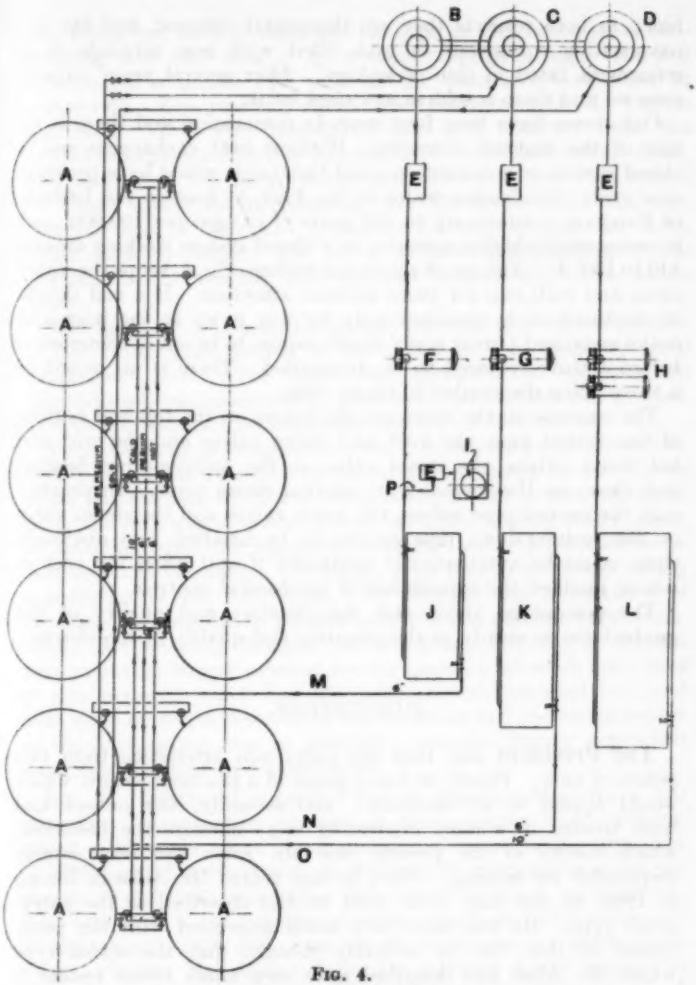

FIG. 4.

CLOSED WATER CIRCUIT.

A Stove.
B Water Balance Tank—Hot.
C Water Balance Tank—Medium.
D Water Balance Tank—Cold.
E Pump.
F Heater: 1 Unit.
G Cooler or Heater: 1 Set of 3 Units.
H Cooler: 2 Sets of 3 Units.
I Existing Caird and Rayner Contact Heater for Make-up Water heated to 160° F.
J Degasser for Hot Water.
K Degasser for Medium Water.
L Degasser for Cold Water.
M Hot: 10,000 gal./hr. at 160° F.
N Medium: 9000 to 10,000 gal./hr. at 110° to 120° F.
O Cold: 15,000 gal./hr. at 90° to 95° F.
P 5000 gal./hr. at 160° F.

fuel; in both respects they are thoroughly efficient, and the de-oxygenating equipment—a tank filled with iron turnings—is a refinement fitted in case of leakage. After several years' experience we find there is seldom any need for it.

Coil stoves have been four years in commission and there is no sign of the slightest corrosion. Without heat exchangers and a closed system or a deaeration plant these coils would have perished in a year. Condensing water in the East, at least in the latitude of Rangoon, contains up to 500 parts of oxygen per 100,000, and is consequently highly corrosive in a closed system working around 140 to 150° F. The use of the closed system, Fig. 4, keeps the water clean and coils run for years without attention. If a coil should be ruptured, it is necessary only to plug it up at the inlet and outlet ends, and a great many would require to be out of commission before a stove required to be dismantled. There is no record of a stove being dismantled to repair coils.

The controls on the stove are the valves on the top and bottom of the central pipe, the inlet and outlet valves and the cold and hot water valves, the steam valve on the melting-down header, and those on the several ¾ in. internal steam pipes. In practice only the central pipe valves, the water valves and the steam valve on the melting-down pipe require to be handled, and obviously these could be automatically controlled if and when the cost of labour justified the installation of mechanical controls.

The percentage yields and the quantity and quality of the product are as steady as the quantity and quality of the charge.

DISCUSSION.

The President said that the paper was interesting from two points of view. Firstly, it was a paper of a practical nature, which would appeal to all members; and secondly, the subject had been treated in a most interesting way—namely, the historical, which history in the present case Mr. Allan had been largely responsible for making. When he had visited Mr. Allan in Burma in 1926, he was busy with what he had described as the curry-comb type. He had been very much impressed with the possibilities of that, but he certainly thought that the actual type which Mr. Allan had described gave very much better results.

There had been little change in the methods adopted for the sweating of paraffin wax during the last forty or fifty years. One method he remembered, which Mr. Allan did not describe, but which was of some interest as an intermediate step, was developed by Mr. Pijzel in Balik Pappan in Dutch Borneo about 1912.

Mr. Pijzel had tried to make the old type of Henderson stove continuous, and had done it in a rather ingenious way. He had constructed a tunnel with rails on the floor, and a chamber at either end. The sweating stoves were made movable, to run on the rails. They were introduced into and removed from the tunnel through the chamber at either end, which had rolling doors, and the heating was carried out by a circulating current of air heated by steam coils. Regular heating over the whole stove was thus ensured, one of the chief objections to the old type of stove being thus overcome. The stove worked quite well in Balik Pappan, but it was the only one ever constructed, so far as he knew.

The figures to which Mr. Allan had referred were from a refinery in the Dutch East Indies, in Java, and he (the speaker) could supplement those. The wages bill, certainly, as expressed on finished wax, was considerably below half that on the other process, as was also the fuel consumption per ton on finished wax.

There were one or two points on which he desired to ask a question. Firstly, as to the difference in temperature between the circulating water and the wax which was being sweated. As in that particular stove the wax was in actual contact with the heating water pipes, he imagined that the temperature of the water pipes had to be very carefully controlled. Secondly, as to the relative fractionating capabilities of the two types. He thought the importance of accurate fractionation in paraffin wax was not perhaps fully recognised. He certainly thought that the colour stability of paraffin wax might be largely affected by the presence of small quantities of oily material which had not been properly sweated out, and that what he might describe as the mealiness and the transparency of the wax, which was so desirable, was also largely dependent upon the closeness of fractionation.

Mr. E. Thornton remarked that it was true that there was no serious manufacture of wax in this country worth talking about. When one heard of installations of stoves having capacities of 5000 tons of finished wax or 30,000 tons charging capacity per month, it did make one realise that we, in England, were playing with technique of the sweating of waxes on a scale which amounted to scratching a little wax from an oil which was not particularly waxy, whereas Mr. Allan's fortunate position would appear to be that of scratching a little oil from the wax which came out of the ground as crude ! In order to make anything like a reasonable tonnage of just over 200 tons per month, he had been getting as much wax as possible from amounts of scale which he could imagine would be disdained by a really first-class up-to-date stove like the Alanmor.

The paper was of extreme interest to him probably because his own problems had not been easy. His firm had what would certainly be looked upon as an old-fashioned stove—i.e., the annular type—but they did get wax by means of it, and a point of great interest which they had had to attack was that not having a first-class stove, they were compelled to make a better scale. It did rather look as though the stove which Mr. Allan described could be almost too good, as though it might be capable of working on scales which ought never to be presented to any stove.

They had found in their own brief experience the most astounding changes in the amount of wax that could be obtained from a given amount of crude, and that the whole technique of sweating really started, or at least had its origin in the treatment before one got anywhere near the stoves. Their early difficulties in making grades of low melting-point were, as they now knew, entirely due to the fact that they were using a thoroughly unsuitable scale, and whilst he did not know the conditions in Burma, it did seem to him that the improvements that could be made by correct attention to the preparation of press cut (both from the point of view of bad colour and of unsatisfactory crystallisation) by the selection of a correct boiling range cut and the exclusion from that cut of asphaltic entrainage, were considerable. It was of such great importance that it almost meant more than the subsequent treatment. He had always had a sort of dictum that a good scale would sweat itself, and he had no doubt that Mr. Allan would agree with that; but even if one had a good scale, there was still a place for the design of the appliances to prevent quite a number of things which made for either poor yields or not very clean scale. One of the excellent points about the stove which Mr. Allan had described, it seemed to him, was that nowhere did one expect any large mass of wax crystals to support itself after the melting away of about 50 per cent. of its bulk. It was this fault that broke down most of the deep stoves, and even with shallow stoves, good sweating was prevented in the first place if the crystal structure was not properly put down, whether because it was not properly cooled or because the material had too much asphalt in it for good crystallisation to occur, and in the second place, if one attempted to take too much out of any one charge.

He had been very much interested to notice that the waxes being produced were largely hard waxes in the two particular statements given. He would very much like to know if Mr. Allan had any experience in the use of this stove for the production of wax of about 100–120° F. melting-point. In his experience, even with the Henderson annular stove which Mr. Allan described as

cumbersome and generally unsatisfactory, they did in fact get good yields. Of the total wax in their scale they got about 75 per cent., but as half of the 25 per cent. which was thrown away was wax they did not want because of its melting-point being too low for the market, they were in fact getting 82 per cent. or so of the available desired wax. Granted they had to sweat and re-sweat, but it did show that with the proper technique, even with old-fashioned equipment, given sufficient patience one could get the waxes that were there in reasonably good condition. It would be interesting, therefore, to have information from Mr. Allan, as Mr. Kewley had mentioned, as to whether the stove described, in addition to being handy and mechanically good, really achieved a very good fractionation, and whether it allowed one to take more off at any given stage. With an ordinary stove, it was inadvisable to sweat away more than 50 per cent. of any one charge before remelting and recharging for recrystallisation. It did seem that it might be possible to get more than 50 per cent. off, and still leave a good running material at the end of sweating, with an Alanmor stove.

On reading the paper several times before coming to the meeting he had tried to think where the heat could go to when using an excess of steam. The figures given in the paper indicated that the Alanmor stove, as used in the tropics he presumed, used a good deal less steam than was used in England, but a great deal more water. How far this was due to being used in a hot climate he did not know, but one could see that a good many of the points of design, as carefully explained by Mr. Allan, arose from the fact that one was using dirty, smelly water in the tropics, neither dirt nor smell being good things for getting clean wax of the grades one wanted.

His firm had had no corrosion problem at all. They were using mild steel cells and quite open tops, and they put in fresh water for each charging. He thought that this was an interesting point as showing how local conditions present different problems. Furthermore, he presumed that a good deal of economy was due to the obviously sound principle of not throwing away a lot of hot water after one had expended steam to make it. It seemed to him that that was almost more important than the excellent design of the stove itself. What caused the high efficiency of the whole assembly was that not only were the principles of sweating sound, but also the principle of using and conserving the hot water produced, as embodied in the exchangers and the three tanks, each with its own kind of water, was a real step forward. It looked as though one might save at least half the present cost of heating by this good arrangement of exchangers. In his experience

that was not done, and he found that their costs were more or less double those given in the paper.

He had been a little intrigued with the time cycle of the stove itself. With his firm's stove they took about 60 to 80 hours over a charge, but only about 40 hours of that was sweating, and in seeing the chart he had been rather disappointed in the similar figures displayed therein. He had previously got the impression that the whole cycle could be done in about 48 hours. That might be so, and he would be glad if Mr. Allan could confirm the optimistic figure of the paper and not the rather disappointing figure of the last chart shown.

Mr. J. E. Hackford said that one of the problems they had encountered in Mexico was the deposition of a bituminous body on the gauzes of the sweating trays. This bitumen was only partly soluble in carbon disulphide but was totally soluble in chloroform. It clogged the gauze and impeded the progress of the sweating operation. To overcome this difficulty it had been found necessary to give the paraffin oil distillate a slight treatment with acid before it went to the presses.

In the process explained by Mr. Allan there are no gauzes, and it would be interesting to know if difficulties due to the presence of bitumen were experienced, and, if so—how were they overcome ?

Mr. A. A. Ashworth said that his experience of wax sweating dated back many years, but he appreciated the difficulties which Mr. Allan had overcome. The ease with which Mr. Allan ought to be able to keep a comparatively small chamber containing a lot of wax at an even temperature must be very great compared with the difficulty which he had been used to find with the big rooms in which the Henderson stoves were used, and the difficulty of keeping an even temperature throughout those.

With regard to Mr. Allan's design, however, he would like to ask one or two questions. He said that in the old Henderson type stove they used to inspect the wax and judge by the colour when the wax was sufficiently sweated. In the case of Mr. Allan's stoves it seemed impossible to inspect the state of the sweating at all ; in fact it was impossible to inspect the internal parts of the stove at all without cutting the thing to pieces. One of the difficulties of a rather later type of Henderson stove than that which he had used, one with a much deeper tray, which he thought formed a 10-in. cake of wax, was that one found that the wax at the bottom of each cake was yellow, whilst the top was white, and it was very difficult to get even sweating with that. In the case of Mr. Allan's stove he noticed that the depth of each section was 30-in., and if it were only possible to see, he would rather expect to find the bottom of

the 30-in. section was still a little bit yellow while the top was fully sweated.

There was one other point in regard to the stove which he desired to mention. He understood that the stove was constructed out in Burma, and probably had to be constructed in the best way that could be done out there; but the whole structure was welded together. If anything went wrong apparently one would have to cut the whole thing to pieces before he could get at the inside. He would like to ask Mr. Allan whether there was any intention to maintain that system of manufacture when the facilities for manufacturing the stove in England were available.

Mr. R. Pitkethly said that he was well acquainted with the obsolete methods mentioned by Mr. Allan and appreciated the progress indicated by the capacity and economy in operation of the new apparatus.

The older method was definitely a two-stage process in the production of white wax from paraffin scale. In the description of the plant it was not clear that sweating from scale to white wax could be completed in one stage, and he would like to have further information.

There was another point on which he asked for information. The Burma white wax produced by the older method was of such a nature that it reverted in colour when exposed to light. It would be interesting to know how the new process affected the final wax in that respect.

Mr. H. L. Allan, in reply, said that with regard to temperature control of the stoves, the practice to begin with was to charge the stoves at a temperature some 10° or 12° above the melting-point of the charge, and to circulate water at the same temperature during charging, the object being not to allow wax to cool and congeal in any part of the stove until the whole was full. To-day, when charging a stove, they allowed the hot water remaining from the previous sweating to stand in the coils without circulation while the hot scale—which might for instance have a melting-point of 132° F.—was introduced. The cost of water circulation for the time was saved, and since the stove and the coils were hot no congelation of scale occurred. Immediately the stove was fully charged circulation of cold water at about 85° F. was started, this being continued until the stove had cooled down some 20° or 25°; that was to say, when the charge was cooled ready for sweating there was usually some 5 or 6 per cent., as far as they could estimate, in the liquid phase, and when the sweating was started naturally the melting-point was similar to the melting-point of the charge, because the contents of the centre tube came

away first, and following that one got the oil coming off in the case of a hard scale at a melting-point of about 98° or 100° F. During sweating the water was controlled very close to the melting-point of the wax and the charge at the time in the stove, (i.e., if they cooled the wax down to a temperature of 115°, they started to sweat with the water at, say, 117°), and the speed of the water through the tubes was kept up so that there was not much more than one degree of difference between the water entering the coil and leaving it. In that way they maintained an even temperature over the whole mass, and that was probably the reason for the apparently large amount of water used, on which Mr. Thornton had commented: the figure was not to be considered as "consumption" of water since the water was merely circulated in an enclosed system. Moreover, it had to be remembered that they in Rangoon found it profitable to re-sweat the first cuts, middle cuts, and so forth in order to extract the greatest possible quantity of white wax; and although the quantity of water was cited in relation to white wax produced, that represented about five times as much scale and sweating charged to the stoves owing to the re-sweating. There was actually only about 4000 gallons of water circulated per ton charged to the stoves. The speed was kept up in cooling and sweating, so that the inlet water and the outlet water were very close together in temperature, and that preserved an even temperature throughout.

As regards the fractionation, he would prefer not to say too much about that, because representatives from the Burmah Oil Company's Laboratories were present and who could say much more about the fractionation than he could himself. Having recently compared the product as between the Alanmor stove and the Henderson stove, Mr. Wilson might be able to say a few words on that later.

With regard to Mr. Thornton's remarks, the plant described was simply a sweating plant; it did not claim to do more than to sweat, and the better the material the better the product. If it got a bad material, it might get bad results. He thought that it would give better results than any other plant he had used, but naturally it would only give results commensurate with the material available. As regards the purification of the wax, he thought he had mentioned in the paper that the chief improvements that had been made were not in the sweating so much as in distillation. He entirely agreed that good fractionation was necessary to obtain good scale.

Then with regard to soft waxes the Records of the Plant showed charges going in varying in melting-point from 100° F. to 132° F.; in fact, in that particular plant they had put in a charge of 96° F.

melting-point, and to cool it down to under 70° they had to put in artificially cooled water in one of the stoves when they were making match paraffins. One could sweat a charge of any melting-point, provided the water was cooled down to the necessary range. In the plant he had described they were producing at the present moment 140°/45° F. wax, 135°/40° wax, 130°/35° wax, 125°/30° wax, 120°/25° wax, and match paraffin 112° F. melting-point, so that probably the full range of waxes were produced.

Then with regard to the amount of wax in the stove, as the sweating proceeded, the daily records showed yields varying from 25 to 40 per cent., (i.e., in the one case 75 per cent. was sweated off, and in the other case 60 per cent. was sweated off), but they had actually sweated off 90 per cent., and they could go down to about 5 per cent., provided there were two sets of pipes supporting it ; the mass of wax remained physically the same, and there was no falling off in efficiency.

With regard to the corrosion problem, Mr. Thornton had really given the answer himself on that matter. The plant was an open top plant, and the only place where one would get corrosion with such a stove would be between what was known as wind and water, but in a closed system the oxygen got to work very much more rapidly and did much more damage.

The exchangers were put in, of course, to avoid dirt in the water, because if dirt got in it simply meant that one had got to take the door off the stove, and put in compressed air or a high pressure water supply, and clean out the coils ; the stoves had not been overhauled in five years' service to date, and no stove had ever been opened to clean or repair anything inside the stove ; and the oldest stove he thought had been running for seven years. Also he thought the exchangers prevented dirt, dust and corrosion, and, what was more important financially, had increased thermal efficiency, the actual fuel consumption working out at about 0·6 per cent.

As to the time cycle shown on the screen, the minimum he had shown he thought was 29 hours. That embraced charging, cooling, sweating and melting—the whole cycle—and the highest cycle might be shown as 48. Forty hours was the maximum necessary ; longer periods shown indicated that the plant had more than overtaken its duty and was deliberately slowed down. Stoves could be manufactured of smaller capacity, say 10 ton.

Mr. Hackford had asked about asphalt sludge. They had thought a lot about that problem in designing the stove, because they did meet with sludge in the older plant, and up to the present they had not had any trouble with the new plant. On the surface of each floor there is ½-in. mesh expanded metal supported on studs, giving about ½-in. clearance between the floor and the gauze as drainage

space during sweating. All he could say was that as far as Burma oil was concerned there was practically no asphalt in it—it might be of the order of 1 per cent. In Assam, the coil type of stove had been working for two or three years, but the old type of grid stove had been working for seven years. The Assam crude contained 8 per cent. of asphalt and about 10 per cent., or it might be more, of paraffin, and there had been asphaltic resins therein, and yet that asphalt had not given any trouble in the stove. He attributed that to the fact that they had abolished the water on which the scale in other plants was usually suspended. The water formed emulsions with the asphalt and dried as a deposit on the floors. The Alanmor stoves when opened were found to be perfectly clean. The asphalt apparently passed away with the sweatings or remained in the wax, and was taken out in the final purification. That was his experience, and presumably for the same reason further he had never experienced any asphalt trouble in mat stoves.

Mr. Ashworth had spoken of design, colour, and observation necessary. The original experiments were done in one single cell. First of all they had had to find out the economic depth. He had thought that they could make a cell 6 ft. deep, not 30 in. deep, but they had made blocks of paraffin in the laboratory and put them in the sweating oven, placed a dye on them, and got the speed of the dye passing through the wax block, and that showed that the approximate economic limit, so far as they were concerned, on their own calculations and opinions, was 30 in. ; and that was why 30 in. was adopted. There was no difficulty in making a stove with cells 6 ft. deep, and good results would be obtained, but not probably so good a time cycle.

With regard to the inspection, as he had said, stoves had been in operation of both designs, one design for seven years and one design for five years, and there had never been any reason or necessity with the coil type of stove to open one up. Stoves had been opened to cut out sections of pipe to establish the fact that corrosion was not taking place and to inspect a cell floor for asphalt : no trace of corrosion or deposit of asphalt or sludge was ever found. One stove had been dismantled completely for the reason already cited, and was rebuilt in 10 days at a cost of less than 10 per cent. of the original cost. It was not necessary to make the stove accessible, accessibility usually meant leakage, dirt and so on ; the necessity for inspection had never arisen, and the day-to-day results, the colours that they got from the charges, were absolutely constant. Observations from their experimental single cell plant which they had on each installation showed that there was no variation from floor to floor—that the wax was of exactly the same composition throughout.

Mr. Pitkethly had asked if the stove could make paraffin in one operation? The Refinery Records showed that hard scale, or any kind of scale, was charged to the stove, and particularly scale of the quality of Burma—he did not say that it could be done with every other scale, it depended on its quality—but Burma scale gave 40 per cent. of finished wax in one operation.

As regards the quality of stability of colour on exposure to light, all he could say about that was that no sweating process that he knew of, or any other process, produced a wax which was stable to bright sunlight if it was exposed for a long time; to make wax absolutely stable to light sweating must be followed by a chemical treatment. It took very, very small quantities of the reverting hydrocarbons, or the impurities, if one cared to call them that, to cause reversion—they were much less than 0·1 per cent. The stove would not produce, nor would any stove produce, from the wax, a paraffin which, without any further refining by acid and/or some of the active earths, would stand up to light indefinitely. They considered that colour stability was improved, in fact they knew it was improved, but still the wax was unstable unless it was followed by a very heavy chemical treatment.

Mr. W. J. Wilson said that the question which Mr. Kewley had asked referred to the degree to which the wax was fractionated. As far as he remembered, they had not in their laboratory compared the fractionation obtained by the Alanmor stove with that which was previously obtained at the refinery. They believed the fractionation was improved, but what they had done was to compare the range of cut, if he might use that expression, of the wax at present obtained with waxes obtained by competitive apparatus, and they did find that the wax presently being produced at Syriam was of narrower cut compared with other waxes. Of course, sweating by its very character could not produce anything which could correctly be described as a narrow cut, but there was a definite difference which the Alanmor stove seemed to produce in that direction.

On the motion of the President, a vote of thanks to Mr. Allan was carried with acclamation.

THE INSTITUTION OF PETROLEUM TECHNOLOGISTS.

TRINIDAD BRANCH.

A General Meeting of the Trindidad Branch of the Institution of Petroleum Technologists was held at the Apex Club, Fyzabad, on February 25th, 1931, the chair being taken by Mr. A. Frank Dabell. The following paper was read :—

Precautions Taken in Drilling Wells in Persia with Cable Tools.

By C. Erik Capito, O.B.E., M.Inst.C.E. (Member).

Lay out.—After the approximate site had been chosen by the Geological Department the general lay out of the well had to be carefully thought out, due to the large amount of H_2S in the gas ; it was usual to allow the well to be placed within 100 ft. radius from the site given.

Where possible the side of a hill was secured to either eliminate or lessen the depth of the cellar and also to give good drainage. Next the direction of the prevailing wind was ascertained and an endeavour made to make the centre line of the rig at right angles to this prevailing wind, the bull wheel brake being on the windward side. A line would also be laid out for the direction of the remote control rod for the master gate to go upwind and finally if steam was to be used for drilling a suitable location was found for the boilers on the windward side of the well. These precautions often meant the building of high pillars to carry the casing and tool racks, but luckily masonry of stone and burnt gypsum was quite cheap and did not materially affect the cost of the well. This hillside system, where practicable, often eliminated expensive concrete rig and engine foundations.

Rig.—The rigs used are the ordinary all steel Californian type with chain driven calf wheel and rope driven bull wheel, but with a variation in having a chain driven sand spool. This latter was driven by a dog clutch on the inside of the pitman bearing, the spool being put into motion by means of a friction clutch. Two brakes, 6 in. wide, were employed on the sand reel similar to those used on ordinary rotary draw works. The derricks for the most part were 80 ft. steel derricks ; no wood derricks were used.

Drilling tools.—For the most part straight bits were used, except when casing had to be carried, in which case eccentric bits were used. When drilling through salt the hole was under-reamed, with the reamer dogs very well dressed out, as considerable difficulty was found in getting casing through salt, especially where any water had been struck in the well ; the salt crystals seemed to build out and seize the casing.

Generally ordinary dart bailers were used, but occasionally sand pumps were run, more especially when drilling in limestone, as these cleaned the well out much better than the dart bailer.

Minimum lengths of bits were strictly adhered to so that, should a bit get broken off the sinker, it would not lie at too great an angle with the sides of the hole to make fishing difficult. For example, a 17-in. bit was not to be shorter than 5 ft. After it had been shortened by continual dressing to less than this length it would then be sent to the main workshop to be turned into a 15-in. bit and so on ; 10-in. bits were not to be less than 4½ ft. 7-in. bits not less than 4 ft., and 4¼-in. bits not less than 3½ ft. By carrying out this practice there was a very small wastage in material.

For a deep hole the following sizes of casing were used : 17 in., 15 in., 13 in., 10¾ in., 9 in., 7½ in. and 6 in., all inserted joint type. All strings were cemented to the surface, except the 17-in. and occasionally the 15-in. ; these strings were landed and were pulled when the 13-in. was cemented, and the 17-in. was pulled when the 15-in. was cemented. The top of the casing was properly centered inside its next largest size to enable a nipple, if necessary, to be screwed in to any size of casing required. This would be useful in case any of the flow head fittings at a later stage broke off and it was found necessary to cap the well on the next larger size of casing. A strain was left on the casing whilst the cement was setting to keep it truly vertical.

Casing was usually set on anhydrite, though if this was not obtained at the depth required a mudstone formation would be used. In every case casing was set on bottom and the seat tested with water pressure to 300 or 400 lbs. per sq. in. at the surface. Cementing was done either by tubing in the larger sizes or by the plug method in the smaller sizes. The plug method was also used on the larger sizes, but it meant the manufacture of so much mud to clean the cement out and also a considerable loss of time in placing the cement that the tubing method was really better.

Where water was struck in a well casing was set on the first suitable seat thereafter and 5 ft. of straight bit hole made, and then eccentric bit hole was carried on until either more water was struck or it was time to set that particular string of casing. When either of these occurred the casing was lifted and the 5 ft. of straight bit

hole under-reamed and casing then lowered to bottom and cemented or again temporarily set.

On an outside test or where it was not certain where the main horizon was going to be found the casing would be set temporarily on the top of any likely looking strata. The casing was then set on bottom and a valve of the same size as the casing was screwed or flanged on with a pressure gauge on its underside. This pressure gauge was placed against the wall of the cellar so that there would be no chance of any tool or other matter falling on it and breaking it. The actual hole through the valve body was only ¼-in. diameter, but tapped ½ in. at surface. The casing valve was fitted with a remote control rod about 80 ft. long with a universal joint at the end of the valve spindle. The rod itself was made of 2-in. pipe screwed together and with 3-in. pipe sleeves over every joint, bolts running through sleeve and rod on both sides of each joint ; where possible this remote control rod was taken to windward of the well. The hole was then filled with water and the casing and valves tested to 300 or 400 lbs. per sq. in. If this stood the pressure satisfactorily the hole was then partially bailed out and a 5¼ in. diameter pilot hole was started. These pilot bits were usually four or five feet long and between the bit and the sinker was fitted a winged guide to suit the size of the casing ; another guide was placed between the top of the sinker and the jars ; this ensured the pilot hole starting in the centre of the hole. These pilot holes were then carried on until either the well got back into salt or mudstone or until a showing of oil appeared. In the latter case the pilot hole was plugged with one or more wooden plugs tightly rammed down and possibly a little cement placed on the top of them. This enabled the casing to be lifted and cemented. In cases where it was necessary to carry the well on the hole was first drilled about 5 ft. with a straight bit and then an eccentric bit would be used instead and the well carried on with this eccentric bit. The use of this straight bit was to fill the pilot hole up with the cuttings and so get a good start for the eccentric bit to work. The use of the eccentric bit enabled a minimum amount of under-reaming to be done.

Drilling in.—When preparing to drill a well in for production a Xmas tree, the full size of the production string, was fitted on the top of the casing. This Xmas tree consisted of a high pressure valve with a pressure gauge fitted on its underside ; a remote control with universal joint was taken from the end of the master gate valve spindle to at least 80 ft. away from the well ; other things being equal, this remote control was taken up the prevailing windward side of the derrick ; a two-way or four-way cross piece with 3-in. or 4-in. valves on the outlets above and on this cross

another high pressure gate valve, also the full size of the casing; this was usually a flanged valve to enable the drilling in gear to be fixed on the top of this valve. The casing, complete with Xmas tree, was then tested to at least 350 lbs. per sq. in. to make sure that all joints and glands were tight. The slightest leak from the casing nipple would be repaired or a new nipple got if the previous nipple could not be tightened to stop leaks. After the test, all bolts were given a further tightening before the job was considered satisfactory. If drilling by steam, the boiler, if not already there, would be moved, if possible, to a high ground at least 300 ft. from the well on the prevailing windward side of the rig, all unnecessary fire bricks would be removed from the fire box and a steam snuffer fitted for immediately cooling off anything likely to remain hot. This snuffer was to be operated either by the boiler attendant or the driller from the rig on the first sign of any danger. When internal-combustion engines were used the exhaust was taken at least 100 ft. from the well to windward of the well. The end of the exhaust would be covered with bricks and stones to make a silencer and to prevent any flames coming out of the exhaust. This long exhaust pipe was usually made by running the ordinary engine exhaust into old 9-in. or 10-in. casing or pipe as it left the rig housing, the junction between these two being made tight by asbestos and clay. The sparking plugs were wound round with asbestos yarn and guards placed over them to prevent any oil or water splashing on to this asbestos and so causing a short circuit.

A flow line was fixed from one of the side valves of the Xmas tree and taken out 300 or 400 ft. up, wind in such a position, if possible, that its end was at a lower level than the Xmas tree. This prevented any pressure being placed on the Xmas tree while the well was being drilled in. In the early days, or on outside tests, the oil flowing out of the valve while the well was being drilled in would be burnt, as the gas was too dangerous to permit it to be exhausted to atmosphere. Nowadays, when drilling-in wells on the main field, the oil, where feasible, was usually allowed to flow to one or other of the flow tanks where the gas and the oil was automatically separated and dealt with.

Drilling and cleaning a well was done through containers. These were lengths of the same size of casing as the production string; the bottom ends being flanged to fit on to the top valve of the Xmas tree, and the upper end fitted with a stuffing box and hollow polished rod. The polished rod also had a stuffing box at its top which fitted tightly on to the rope to prevent oil or gas coming out through the rope. It was also usual to fit a water hose on to the underneath side of this polished rod stuffing box and pump water in here to prevent gas and oil from coming out round the rope; a

half-inch connection was suitable. The bottom end of the polished rod was fitted with a collar which prevented it from being blown out through the stuffing box. These containers were usually at least 40 ft. long. A rat hole was drilled to the side of the well to enable the tools to be made up and then brought in to the container. The containers were slung from one of the derrick girths so that they hung there while the tools were being changed. Guys were also fixed on to these containers to prevent any wobble while drilling or bailing. The crown block was centred on the water table so that the drilling line was vertical over the top of the drilling-in container when it was fitted on to the Xmas tree. On the underside of the crown block, and underneath the drilling and sand line sheaves, a steel plate was fitted to prevent the polished rods from being carried up and throw the lines off the sheaves in case anything carried away.

Drilling-in was carried out by spudding, a spudding shoe being fixed on the drill-line a little above where it left the bull wheel. A platform was fitted up in the derrick to enable men to have easy access to the stuffing box and polished rod on the containers. This platform was so fixed that it was a comparatively close fit round the containers and was fenced in on three sides of the derrick with expanded metal which prevented any man from falling off this platform in the event of his getting gassed. The fourth side was also partially wired in, but on this side a lift was hung on by two wire lines to pull the men up to the platform and take them down. While men were up in the derrick the box was left level with the platform so that if a man got gassed or felt himself getting gassed, all he had to do was to jump into the box and it automatically lowered itself to the ground. It was usual to keep one gas mask and a bottle of smelling salts on this platform on the windward side of the container. Whilst drilling was being carried on at least two men were employed on this derrick platform and more often three or four were there. Other gas masks, smelling salts and eye lotion were kept in a suitable position near the well.

When the tools reached bottom, the polished rod was drawn up to its correct position and tightened on to the drill-line; this polished rod has to be adjusted every 2 ft. Drilling then proceeded until about 5 or 6 ft. have been drilled and then, if necessary, the tools were pulled out and the bailer run. For the first part of the way up the tools could be pulled at full speed, but on nearing the top, and the driller knew where his line ought to be on his bull wheel, he slowed up the tools until they touched the polished rod. This came up with the tools and he was able to stop his tools so that they did not hit the top of the container. The top valve on the Xmas tree was then closed and the container flange uncoupled and swung to one side, the bailer container being then swung into

position and flanged up. The bailer was run in a similar way as the tools were run after opening the top valve again. Before re-inserting the tools all joints were examined by running the tools into the rat hole and the bit changed where necessary. The junction of the wire line and swivel was examined at least once a day.

It was found that as soon as oil started to flow there was no necessity to run the bailer, due to the cuttings coming up with the oil. Where samples of the cuttings were required an L was placed on one of the side flow valves with a wire gauzebag tied on this L and the oil allowed to flow into this, bringing up the cuttings. Sufficient cuttings were obtained in this manner for geological purposes. When oil was flowing it was not necessary to pull the tools up every 5 ft., though they were pulled up every now and then for inspection; as each 2 ft. were drilled the men in the derrick would alter the position of the polished rod on the drill-line by slackening off the top of the stuffing box and lifting the polished rod and then re-tightening the stuffing box. The production of the well was measured on the flow line by thieving samples of the oil and gas being produced through a Pitot tube, getting the gas/oil ratio thereby; a formula was worked out for each size of line based on actual practice observed. This formula was only correct when there was no surge.

After oil had started to flow no drilling was carried on if there was no wind, otherwise the men up in the derrick might easily have been gassed.

The only oil seen at a well being drilled in was that which came off the tools and out of the containers and also out of the side valve when taking samples of the cuttings. In addition an occasional wisp of oil and gas would come out through the stuffing box on the drill and sand lines if the water supply to these stuffing boxes had got shut off; otherwise only water would come out at these places.

Before starting to drill-in a well all lights were removed from the derrick, and whilst actually drilling-in no work was carried on at night time; flood lights were placed round the well at about 100 to 150 ft. distance for use in emergency. Outside test wells often had no lights put in the derrick and flood lights were used from the very start.

It is interesting to state that since the advent of these containers only one well got away out of control, and this was due to striking a show of oil and gas before it was expected—luckily not a large one—and it did not take long to get the well under control again and the show mudded off.

These containers were very useful for swabbing a well or starting a well flowing again by swabbing, as the swab could be drawn

into the container and the top valve closed and the well turned on to the bean once more. This would necessitate two side flow valves, one with the bean and one for open flow to take care of the oil coming up with the swab.

The author is much indebted to the chairman and directors of the Anglo-Persian Oil Company for permission to give this paper.

DISCUSSION.

In the subsequent discussion, in which Messrs. L. A. Bushe, R. N. Kirby, A. H. Richard, W. N. Foster, W. J. C. Cooke, B. M. Craig, G. A. Richards, J. L. Harris, G. H. Scott, A. P. Chamberlain, D. P. Rees and A. Frank Dabell took part, questions were asked regarding the depths of the wells; the reasons for running seven strings of casing; why each string of casing was cemented to the surface; whether long exhaust pipes impaired engine efficiency; whether the hole was wet or dry when drilling, and if mud-laden fluid would give necessary safety without using a container; if the eccentric bit gave a straighter hole than an ordinary bit; if there was any difficulty in cementing off salt water; why mud was used in cementing instead of water in the tubing method; whether coring of the oil-bearing limestone had been carried out; why a guide was fitted below the sinker; what pressures were obtained in the wells and whether the pressure increased suddenly or gradually on drilling-in; whether the cellar had a run-way for the crew to escape in an emergency; if remote-control rods of 80 ft. in length could be relied on; and if pressure increased with depth, could the rising oil be relied on to bring up the detritus.

Mr. C. E. Capito, in reply, said that for wells five to six thousand feet in depth seven strings of casing were used and for wells of two to three thousand feet only two or three strings were used. Casing was cemented to the surface in order to counteract corrosion. The engine exhaust was run into 9- or 10-in. casing and so no back pressure was applied, the efficiency being maintained. When drilling-in the hole was dry, and if mud was used when drilling-in the progress of drilling would be too slow. With reference to eccentric and straight bits, he did not think there was much difference in regard to straightness of the hole, but the eccentric bit reduced the necessity for under-reaming. No difficulties were met with in shutting off salt waters, it being customary to circulate fresh water for two to three hours before cementing. In shallow wells, water was used behind the cement, but in deeper wells mud was used to balance pressures inside and outside the casing. Cores had occasionally been taken but the normal bailer samples were generally good. The purpose of the guide between the sinker and

the bit was to ensure the pilot hole being central. Pressures varied from a few hundred to three thousand pounds, and there was very little increase with depth. As soon as cuttings ceased to come to the surface, drilling was stopped and the bailer run until sufficient oil was obtained to bring the cuttings up with it. A run-way was provided in the cellar so that the wind would blow out any gas and, in the event of there being no wind, the men wore gas masks or smoke helmets. There was no trouble with long remote-control rods provided that the joints were strengthened with sleeves.

The meeting closed with a vote of thanks to the members of the Apex Club for the use of the room.

Control Methods in Fractionators.*

By S. S. Smith.

There is a popular conception among operators of the class of rectifiers commonly known as stabilizers that maximum reflux controlled continuously against a fixed column pressure and fixed

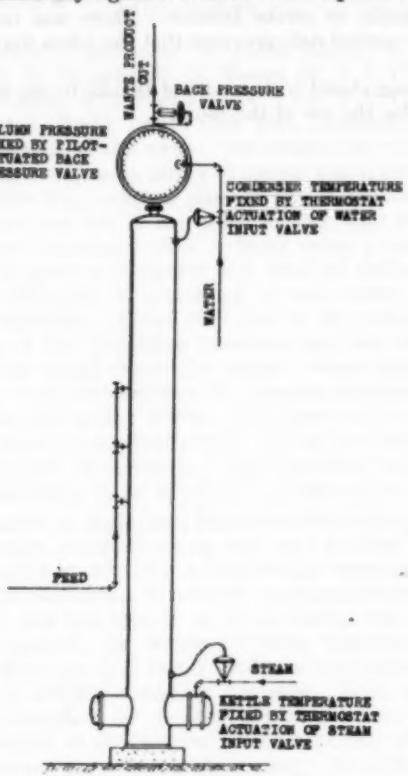
WASTE PRODUCT
CO2
BACK PRESSURE VALVE
COLUMN PRESSURE FIXED BY PILOT-ACTUATED BACK PRESSURE VALVE
CONDENSER TEMPERATURE FIXED BY THERMOSTAT ACTUATION OF WATER INPUT VALVE
WATER
FEED
STEAM
KETTLE TEMPERATURE FIXED BY THERMOSTAT ACTUATION OF STEAM INPUT VALVE

Fig. 1.

kettle temperature will give highest efficiency in the fractionator with highest yields of given vapour pressure product. In refineries, natural gasoline plants, etc., controlled product is usually con-

* Paper received July 18th, 1931.

sidered to be the bottom product, and since the feature of this product which is most easily controlled is vapour pressure, most operations of such nature are predicated upon controlling vapour pressure of bottom product. It is difficult to discuss in clear language all of the causes and effects which ultimately affect efficiency in stabilizer columns, but the writer holds the theory that, as popularly conceived, the control features of stabilizers neglect an obvious point of efficiency or ultimate yield of gallons of given vapour pressure of product. This paper attempts to analyze the features of various types of control and to point out possibilities for improvement in conventional methods.

Four cases in usual and current use are cited, and will be taken up individually. Case 1 (Fig. 1) indicates control of temperature at bottom and top of fractionated column with back pressure valve controlling pressures. If the feed to such a column is a true binary mixture and purity of both tops and bottoms is desired, it may be used with satisfaction. If anything other is true than a binary mixture of feed at column and there is any variation of composition of feed, this control in effect attempts to resolve a feed of varying vapour pressure into two products of constant vapour pressure—a manifest impossibility. In practice with feed of varying vapour pressure, column will flood or operate with insufficient reflux, and in either case true equilibrium conditions will not be maintained.

Case 2 (Fig. 2) embodies fixed temperature control of kettle, fixed pressure control of column with maintenance of fixed amount of reflux in practice usually using the maximum rating of heat exchange apparatus. In some cases this control is augmented by addition of a float control behind the reflux weir, which controls water input to column in such fashion that amount of reflux is regulated to a constant. This second case is, the author believes, the most popular type of control apparatus for use in natural gasoline plant stabilizers, and is also largely used in stabilizers processing yield of recovery plant gasoline at refineries. Within the physical limitations of the heat exchange apparatus and the column proper, this type of control does maintain fixed vapour pressure of derived bottom product always in the presence of reflux volume either automatically or hand controlled to maximum or nearly maximum rates. At first thought it may be said that if a particular column operates always at maximum reflux rates and controls bottom product always to the desired vapour pressure, then maximum efficiency must be maintained. However, in certain cases it is easy to prove that this is not strictly true.

To take the simplest example, let us suppose that a column operates on a feed containing as average an amount of butane

which can be retained in the bottom product without exceeding vapour pressure limitations, but from hour to hour varies in butane and propane composition in such fashion that at times there is deficiency of butane for required vapour pressure of bottoms, and at other times there is excessive butane. On such

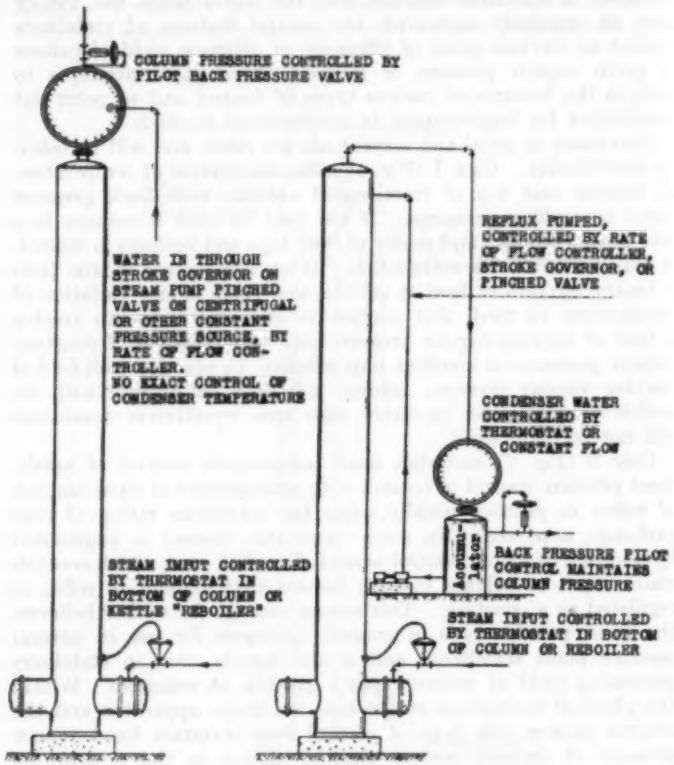
COLUMN PRESSURE CONTROLLED BY PILOT BACK PRESSURE VALVE
WATER IN THROUGH STROKE GOVERNOR ON STEAM PUMP PINCHED VALVE ON CENTRIFUGAL OR OTHER CONSTANT PRESSURE SOURCE, BY RATE OF FLOW CONTROLLER. NO EXACT CONTROL OF CONDENSER TEMPERATURE
REFLUX PUMPED, CONTROLLED BY RATE OF FLOW CONTROLLER, STROKE GOVERNOR, OR PINCHED VALVE
CONDENSER WATER CONTROLLED BY THERMOSTAT OR CONSTANT FLOW
ACCUMULATOR
BACK PRESSURE PILOT CONTROL MAINTAINS COLUMN PRESSURE
STEAM INPUT CONTROLLED BY THERMOSTAT IN BOTTOM OF COLUMN OR KETTLE "REBOILER"
STEAM INPUT CONTROLLED BY THERMOSTAT IN BOTTOM OF COLUMN OR REBOILER

FIG. 2.

an operation, it must be obvious that during periods when there is deficiency of butane, some amount of propane will be held in bottoms sufficient to supply vapour pressure as determined by kettle temperature and pressure. At other times, when there is excessive butane over allowable composition as established by kettle temperature and pressure, the excess butane will be thrown

overhead in the waste product with an attendant rise in temperature at condenser due to change of composition of waste product. Admittedly, the instance cited is such as to prove readily that there may be operations in which the apparently logical Case 2 control is not most efficient. If, however, we consider the reasoning

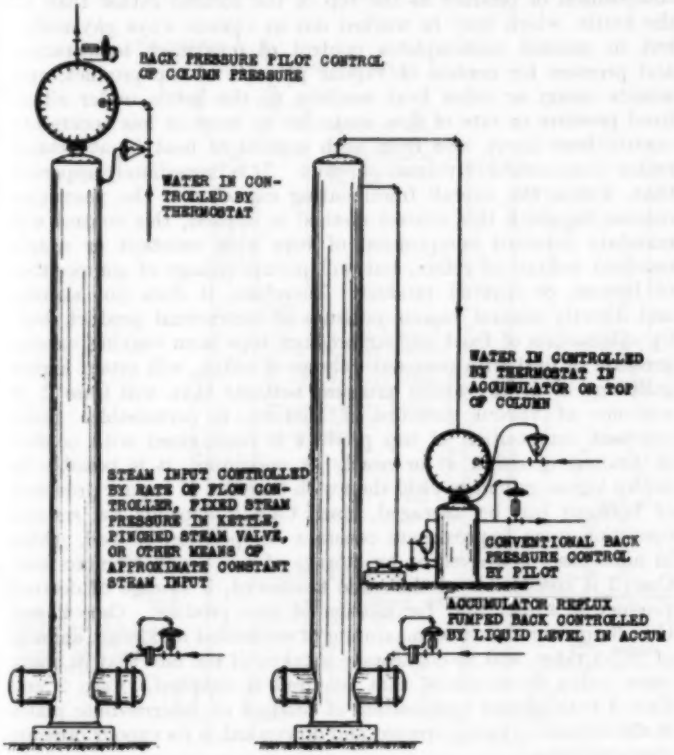
BACK PRESSURE PILOT CONTROL OF COLUMN PRESSURE
WATER IN CONTROLLED BY THERMOSTAT
STEAM INPUT CONTROLLED BY RATE OF FLOW CONTROLLER, FIXED STEAM PRESSURE IN KETTLE, PINCHED STEAM VALVE, OR OTHER MEANS OF APPROXIMATE CONSTANT STEAM INPUT
WATER IN CONTROLLED BY THERMOSTAT IN ACCUMULATOR OR TOP OF COLUMN
CONVENTIONAL BACK PRESSURE CONTROL BY PILOT
ACCUMULATOR REFLUX PUMPED BACK CONTROLLED BY LIQUID LEVEL IN ACCUM

FIG. 3.

embodied in the instance cited and extend it to, for instance, a refinery application where there are high percentages of unsaturated cyclic and other compounds with boiling points close together, it must be apparent that any type of control which at times substitutes a smaller volume of higher vapour pressure component for a possible larger volume of lower vapour pressure component is not theoretically the most efficient in yield of highest gallonage

of desired vapour pressure. In Case 2 the reflux volume is controlled either by hand or by automatic features by control of volume of water admitted to condenser. In other words, reflux volumes are controlled from the top or condenser end of the column.

Case 3 (Fig. 3) embodies a different control of reflux and controls composition of product at the top of the column rather than at the kettle, which may be worked out in various ways physically, but in general contemplates control of condenser temperature and pressure for control of vapour pressure of top product, and admits steam or other heat medium to the kettle under either fixed pressure or rate of flow controller to more or less accurately control heat input, and from such control of heat input attains rather close control of volume of reflux. It is immediately apparent that, within the overall fractionating capacity of the particular column to which this control method is applied, this control will maintain constant composition of tops with constant or nearly constant volume of reflux, but will permit change of composition of bottom or derived product. Therefore, it does not strictly and directly control vapour pressure of commercial product, but, by subtraction of fixed vapour pressure tops from varying vapour pressure of feed with constant volume of reflux, will attain higher gallonage of given vapour pressure bottoms than will Case 2, if variance of vapour pressure of bottoms is permissible. Since constant composition of top product is maintained with control of amount of reflux at or nearly at maximum, it is possible to derive higher gallonage yield than with Case 2. If vapour pressures of bottoms can be averaged, since Case 2 depends for smooth operation upon approximate constant composition of feed, which in most cases is arrived at by storage of raw product before feed, Case 3 is susceptible of the same treatment, if storage of derived product is substituted for storage of raw product. Case 2 and Case 3 operate always at maximum of controlled maximum amount of reflux rates, and no cognizance is taken of the fact that in many cases reflux in excess of that required is supplied. Case 2 and Case 3 both permit composition of product on intermediate plates in the column to swing upward and downward in its vapour pressure characteristics.

Case 4 (Fig. 4) controls top temperature and pressure in the column and, therefore, controls composition of tops within the limitations of efficiency of operation in the plates adjacent to condenser. It uses also a thermostat just above the feed plate to control admission of steam or other heating medium to the kettle in such fashion that constant temperature and, therefore, constant vapour pressure is maintained just above the feed plate. Therefore, constant temperature gradient is maintained throughout

the rectifying section of the column from feed plate to condenser. With constant temperature gradient maintained in the rectifying column, constant composition gradient is also maintained throughout the same section, and since constant composition gradient implies constant ratio of vapours to reflux, top product is main-

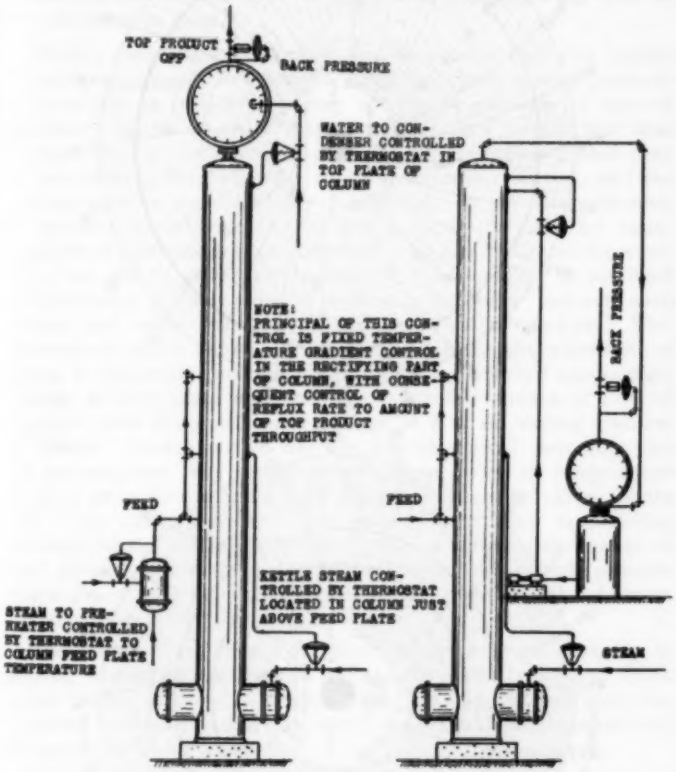
TOP PRODUCT OFF
BACK PRESSURE
WATER TO CONDENSER CONTROLLED BY THERMOSTAT IN TOP PLATE OF COLUMN
NOTE: PRINCIPAL OF THIS CONTROL IS FIXED TEMPERATURE GRADIENT CONTROL IN THE RECTIFYING PART OF COLUMN, WITH CONSEQUENT CONTROL OF REFLUX RATE TO AMOUNT OF TOP PRODUCT THROUGHPUT
FEED
FEED
KETTLE STEAM CONTROLLED BY THERMOSTAT LOCATED IN COLUMN JUST ABOVE FEED PLATE
STEAM TO PREHEATER CONTROLLED BY THERMOSTAT TO COLUMN FEED PLATE TEMPERATURE
BACK PRESSURE
STEAM

FIG. 4.

tained constant in vapour pressure with constant reflux ratio to top product withdrawn. Any column controlled in such fashion maintains static equilibrium conditions throughout the rectifying section of the column, and there is, as a result, a minimum amount of composition surge or hunt. Consequently, the column is not ever forced to fractionate beyond its actual throughput rate in

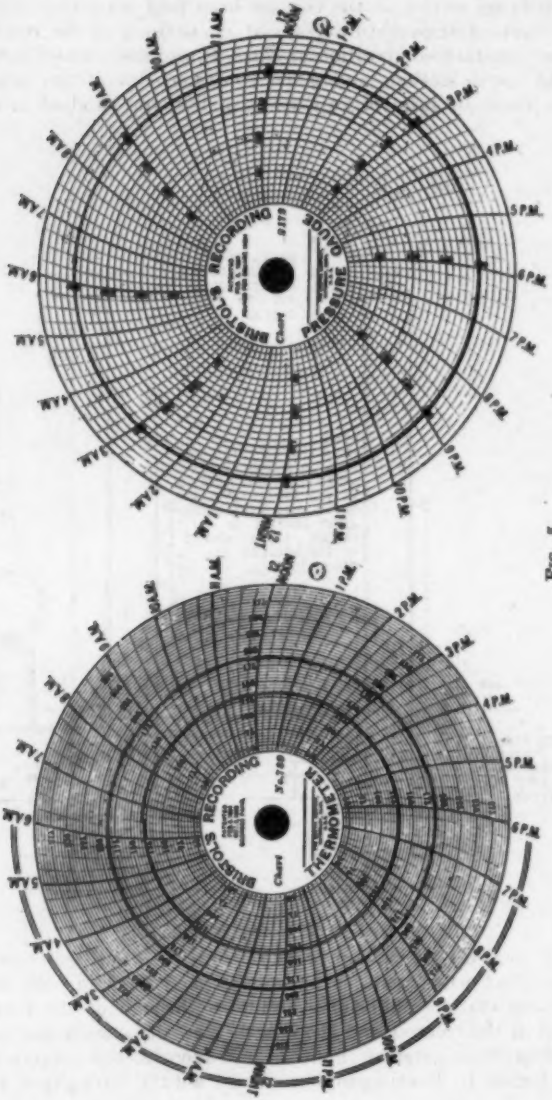
RECORDING
BAROMETER
PRESSURE
RECORDING
BAROMETER
THERMOMETER

FIG. 5.

order to seek new equilibrium conditions as in the case where we permit top product composition to vary, in order to attain consistency of bottom product vapour pressure. In this control advantage is taken of the fact that, as the writer sees it, the highest possible yield of product of given vapour pressure characteristics is maintained with no over or under specification losses, such as are obtained in Case 2.

From a practical side, it must first be evident that this control is usable only if sufficient storage of run down from column products is available to permit averaging up vapour pressure of derived product. If this is a disadvantage, it is offset by the fact that widely varying compositions and vapour pressures of feed may be successfully handled with entirely automatic control, and the column may be permitted to operate with an absolute minimum of personal attention. The controller apparatus used for maintenance of pressure and temperature need not be unusually sensitive, but should preferably be selected for its ability to set itself to throttling position with a minimum tendency towards snap action and wide variation in rates of flow of medium. The thermostat which controls from the feed plate the admission of steam to the kettle must take care of time lag between temperature change at feed plate and resultant controlled change of flow of vapours from the kettle after change of flow of heating medium to kettle. Consequently, this thermostat should purposely not be too sensitive, but should permit slight swing of temperature at feed plate between full open and close of motor valve. Since any snap action of the back pressure controller maintaining pressure on the column is transmitted as a temperature change at feed plate by flashing or condensing vapours, the back pressure valve also should be one which maintains pressure with minimum variance of rate of flow.

The proper sizing of motor valves to the required capacity in cooling or heating medium is perhaps the most important single point in the effecting of proper control in Case 4, and attention to detail in this respect will be amply repaid in finished smoothness of operation of the column.

Fig. 5 shows the recording thermometer and pressure gauge charts from a column operating under the system of control (Case 4) described. Close inspection will reveal that there has been a very slight variation in the temperature at pressure and condenser, which indicates a change in load conditions on the column which required control swing at the pilot valves to compensate. Otherwise, it will be noted that the charts indicate unusually smooth operation with perfect maintenance of equilibrium conditions.

CURRENT PETROLEUM NOTES.

Alberta Tar Sands.—Bitumen at the rate of 20 brls. per day is now being produced from the Alberta tar sands in the plant of the International Bitumen Co. at McMurray. It is anticipated that changes in the dehydrating plant will increase the production during next summer to about 200 brls. per day.

Canadian Oil Production.—For the first six months of 1931 the production of petroleum in Canada amounted to 937,779 brls., of which 872,000 brls. were produced in Alberta, 62,070 brls. in Ontario, and 3,709 brls. in New Brunswick. The production during the corresponding period of 1930 was 639,884 brls.

Turner Valley Natural Gas.—It is proposed that over forty companies producing natural gas in the Turner Valley shall enter into an agreement for the pooling of gas and for its sale to cities in Alberta. This agreement may mean that only 10 or 12 wells out of 85 will be operated to obtain maximum recovery of naphtha from the permitted gas flow. The necessity for action to restrain wastage is evidenced by the fact that at the end of 1928 about 70,000,000 cu. ft. of gas were wasted daily, and in June, 1931, this figure had reached 560,000,000 cu. ft.

The wells in the Turner Valley field vary in their naphtha production, the best yielding 1 brl. per 20,000 cu. ft. of gas, while many require 400,000 to 800,000 cu. ft. for the same quantity of naphtha.

REVIEWS.

HYDROGENATION OF ORGANIC SUBSTANCES, INCLUDING FATS AND FUELS. By Carleton Ellis, S.B. Third edition, pp. xxiv. + 986. London, George Routledge & Sons, Ltd., 1931. £3 3s.

This monumental work, now in its third edition, gives a unique and authentic statement of the present position of hydrogenation.

The vast amount of material here collected is staggering; the author index alone runs to 20 double column pages, and the subject index to 56 pages.

This colossal accumulation of fact has been due, in the first instance, to the rapid development in the practical hydrogenation of fats on the large scale—the so-called "hardening" of fats worked out between 1910 and 1920—and secondly to the hydrogenation of carbonaceous materials—coal and oil—first attacked technically by Bergius and ultimately by the great chemical corporations and the great oil companies. Going on *pari passu* with these operations has been laboratory researches on the reduction of almost every type of chemical compound, the investigation into the catalytic activity of a wide range of materials and the development of the mechanism of catalysis.

The author truly points out that:—"Many years doubtless must elapse before the numerous assertions and findings shall have reached the stage of discard or confirmation. In the chapters relating to hydrogenation of coal and mineral oils and their residues, and of carbon monoxide, the author has made a complete review of the work accomplished to date, in so far as the data are disclosed by publication. Furthermore the text which follows does not overlook the growing importance of hydrogenation as one of the tools of research in connection with the identification of unsaturates of unknown constitutions."

Merely to quote chapter headings would be impossible in the space allotted to a review. But in brief the first 13 chapters are occupied with a general statement of the underlying principles of hydrogenation, adsorption, poisons, inhibitors, promotors, experimental procedure, and the chief groups of catalytic agents, their preparation and application. The succeeding 17 chapters are concerned with the actual hydrogenation of the chief types of

organic compounds, with an interesting chapter on miscellaneous hydrogenations of biological interest; sterols, cholesterol, carotin, lecithin, and so forth.

Another 10 chapters are devoted to the technical hydrogenation of fatty acids and glyceride and the fat-hardening industry.

To the petroleum technologist no doubt the most interesting part of the work relates to the hydrogenation of coal and oil and the products of the reduction of carbon monoxide. No less than 200 pages are taken up by a mass of information—historical records, present-day accomplishments and patent specifications.

The names of Bergius, Tropsch, Kling, Florentin, Waterman, Krauch, Ipatiev, Sabatier, Mailhe, Audibert, Patart, Fischer, just taken at random from these immensely interesting columns, indicate that all the masters of the craft are represented.

It would be impossible to over-praise such a work as this. It is trite to say that it is "indispensable to every chemist"; it is truly a work of reference that will stand as a monument to the patience, the knowledge and the resources of the author. A. E. DUNSTAN.

A HISTORY OF THE BRITISH CHEMICAL INDUSTRY. By Stephen Miall. London, Ernest Benn, Ltd., 1931. 10s. 6d.

This little book of Dr. Stephen Miall's is intended as a permanent souvenir of the Jubilee meeting of the Society of Chemical Industry.

Sir Harry McGowan in an inspiring foreword says:—

"The vast field covered by the chemical industry to-day is largely the result of co-operation which is taking place between the chemist and biologist, the chemist and physicist, the chemist and the engineer, the chemist and the electrical engineer—the marriages of chemistry and almost every other science. The chemical industry is the most polygamous of all industries."

He points out that Great Britain has a greater force of skilled technicians and enhanced power of research, and infinitely greater resources of capital than ever, and therefore "to be worthy of our fathers is to surpass them."

The author has attempted in the compass of 264 pages to give a summary of the history, development and present position of the major chemical industries of the country, and he has, on the whole, succeeded in so doing.

As he says, it is not easy to define chemical industry, but "if we include the manufacturers of the ordinary chemicals, dyestuffs, drugs, fertilisers, disinfectants, soap, paints, by-products from gas-works and coke-ovens, explosives, oil, artificial silk, ink, starch, blue, and polishes, the total capital invested in this country is probably in the region of £300,000,000, and the number of workers employed can hardly be less than 160,000 or 170,000."

The chief industries considered by Dr. Miall are heavy chemicals; dyestuffs; fermentation products; drugs and fine chemicals; cellulose and its derivatives; metallurgy; gas, coke and tar; paint and varnish, and soap.

It will be noted that the already considerable petroleum industry is not included. This is a serious omission, because to-day in the country there are at least four major refineries with a significant throughput and a wide range of products. Some space might have been found for the Scottish Shale industry, if only because it was a pioneering development that provided the foundations for the distillation and treatment of mineral oil.

A statement on page 263 will interest members of our Institution—"Several other organisations exist for the convenience of various sections of chemistry . . . the Institution of Petroleum Technologists. . . ."

In spite of the above comments the book is eminently readable and should find a place in the library of every industrial chemist.

The author has done his work well, but he might have been better supported by his publishers—the half-tone blocks are smudgy. A. E. DUNSTAN.

BOOKS RECEIVED.

REPORT OF COMMITTEE D-2 ON PETROLEUM PRODUCTS AND LUBRICANTS AND METHODS OF TEST RELATING TO PETROLEUM PRODUCTS. American Society for Testing Materials, 1315, Spruce Street, Philadelphia. $1.25.

The American Society for Testing Materials has issued the annual report of its Committee D-2 on Petroleum Products and Lubricants, together with the reports of several Sub-Committees; included in this publication are 33 standard methods of test and 14 tentative test methods for products in this field.

Standard methods of test are included for the determination of bitumen; burning quality of kerosine oils and of mineral seal oils; carbon residue of petroleum products; cloud and pour points; colour of lubricating oils, of petrolatum and of refined petroleum oil. Tests for the dilution of crankcase oils, distillation of crude petroleum, gasoline, naphtha, etc., flash points, gravity by means of the hydrometer, and the analysis of grease are also given.

Included are standards for testing electrical insulating oils; melting point of paraffin wax and of petrolatum; penetration of bituminous materials and of greases and petrolatum; precipitation number of lubricating oils; sampling; saponification number; softening point of bituminous materials; sulphur in gasoline and in motor fuels, etc.; also tests for thermal value of fuel oil; vapour pressure of gasoline; viscosity of petroleum products; water and sediment in petroleum products, and several other standard methods of test.

Tentative definitions of terms relating to petroleum products are given.

REPORT ON TOUR OF INSPECTION OF THE OIL-FIELDS OF THE UNITED STATES OF AMERICA AND ARGENTINA, AND ON OIL PROSPECTS IN AUSTRALIA. By W. G. Woolnough. Pp. 118. Canberra: H. J. Green, Government Printer. 5s.

This work deals with a visit made by Dr. W. G. Woolnough, Geological Adviser to the Commonwealth Government of Australia, to study oilfield developments in the United States and in Argentina, and the knowledge thus gained is applied to the consideration of the prospects of finding oil in Australia. In his summary the author states: "The prospects of obtaining oil in various parts of Australia are weighed, and it is concluded that, given intelligent, active, honest and up-to-date methods, the prospects are good. It is considered that the introduction of overseas capital and technique, under stringent safeguards, is desirable."

To all interested in the search for oil in Australia, this report will make interesting and valuable reading.

THE OXIDATION OF HYDROGEN, CARBON MONOXIDE AND THE PARAFFIN HYDROCARBONS BY COPPER OXIDE. By J. C. King and L. J. Edgcombe. Pp. vi.+28, London, H.M. Stationery Office. 9d. net.

REPORT OF TEST BY THE DIRECTOR OF FUEL RESEARCH ON THE PLANT OF THE LEICESTERSHIRE (L. and N.) COAL DISTILLATION COMPANY, LTD., AT NEWBOLD, NEAR ASHBY-DE-LA-ZOUCH. Pp. vi.+28. London: H.M. Stationery Office. 9d. net.

LIGHT SPIRITS FROM THE LOW TEMPERATURE CARBONISATION OF COAL. By D. Hicks and J. G. King. Pp. vi.+26. London: H.M. Stationery Office. 6d. net.